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On the cover: Zyngoonops beatriceae, new species, female, posterior uterine sclerite, anterior view.

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The Goblin Spider Genus *Zyngoonops* (Araneae, Oonopidae), with Notes on Related Taxa

Wouter Fannes

Bulletin of the American Museum of Natural History

THE GOBLIN SPIDER GENUS *ZYNGOONOPS* (ARANEAE, OONOPIDAE), WITH NOTES ON RELATED TAXA

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ABSTRACT

The goblin spider genus *Zyngoonops* Benoit, 1977 is revised. The type and hitherto only species, *Z. clandestinus* Benoit from the Democratic Republic of Congo (D.R.C.), is redescribed on the basis of topotypical material. Nine new species are described from the D.R.C. (*Z. moffetti*, *Z. redii*, *Z. goedaerti*, *Z. rockoxi*, *Z. beatriceae*, *Z. chambersi*, *Z. swammerdami*, *Z. markî*) and the Central African Republic (*Z. walcotti*). Members of *Zyngoonops* show remarkable modifications of the sternum and pedicel tube: the sternum has two heavily sclerotized posterior extensions, and the pedicel tube has a protruding ventral lip. The female genitalia are complex, consisting of an epigastric scape, two uterine sclerites, and a long genital duct. In most species, the distal part of the duct is highly coiled. Males resemble those of *Antoonops* Fannes and Jocqué and *Coxapopha* Platnick in having elaborately modified endites, a pair of pleural flaps, and a carapace with extended anterolateral corners. The type species of *Coxapopha* is redescribed, and new images of the female genitalia of *Antoonops* and *Coxapopha* are provided. A cladistic analysis of morphological characters provides support for the monophyly of *Zyngoonops* and identifies *Z. redii* as the most basal species of the genus.

INTRODUCTION

The spider genus *Zyngoonops* includes only one species, *Z. clandestinus* Benoit, 1977, from the D.R.C. This species ranks among the most enigmatic of all African goblin spiders. Only one specimen, an adult female, is currently known, and that specimen is bleached and severely damaged, so that little can be said of its detailed morphology. The original description mentions some diagnostic characters (Benoit, 1977: 246), but only few of these characters are illustrated. Thus, neither Benoit's description nor the holotype offers much insight into the morphology of *Z. clandestinus*.

Recently, a second female was discovered among unsorted material in the Royal Museum for Central Africa. The discovery of the new specimen prompted a detailed morphological study of *Z. clandestinus* (figs. 1–7, 102), which showed that Benoit's (1977) description is not entirely accurate. For example, according to Benoit, the eyes are reduced to "two small depigmented patches" (Benoit, 1977: 246: "Yeux absent. A l'emplacement normal des yeux se situent deux petites taches dépigmentées"). His drawings of the carapace do not show the patches (Benoit, 1977: figs. 6, 7), suggesting that these structures must be very small indeed. Contrary to Benoit's claims, however, *Z. clandestinus* has two well-developed eyes (fig. 3B). Another inaccuracy concerns the morphology of the epigastric scape. In Benoit's paper, the scape is depicted as triangular, but this structure actually has a different, more complex shape (figs. 1F, 7B, 105A).

Zyngoonops clandestinus has two very unusual features: a sternum with two posterior extensions (fig. 3C–F) and a pedicel tube with a ventral lip (fig. 5D–F). The sternal extensions, here called prongs, are heavily sclerotized (fig. 102C) and protrude behind the posterior edge of the carapace (fig. 3D). Their dorsal surface is covered by fine, transverse ridges (fig. 3E). The outer surface of the lip is also covered by transverse, regularly spaced ridges (fig. 5D, E), except in the middle, where the lip appears to be constricted (fig. 5D). The prongs and the lip presumably constitute a stridulating organ: the spider could produce sound by scraping the lip over the dorsal surface of the prongs.

The Goblin Spider PBI team (see www.research.amnh.org/oonopidae) recently discovered nine new species that strongly resemble *Z. clandestinus* in somatic and genitalic morphology. The new species, all from Central Africa, have an epigastric scape and sternal prongs, and at least eight of them have a pedicel tube with a ridged ventral lip. Furthermore, their internal female genitalia closely resemble those of *Z. clandestinus* (see below). Given these similarities, they are here placed in *Zyngoonops*, bringing the total number of species in the genus to 10.

These 10 species probably represent only a small fraction of the true diversity of *Zyngoonops*. Many regions in Central Africa remain poorly surveyed for oonopids, for example, the Central African Republic,

Congo-Brazzaville, and the Orientale and Equateur provinces of the D.R.C. The available samples from the Kivu region indicate that the local species richness can be high (see maps 1–5). It is to be expected, therefore, that further exploration of the forests of equatorial Africa will result in the discovery of numerous new *Zyngoonops* species.

The genus shows considerable variation in carapace shape (figs. 31A, 45B) and scutum development. The abdominal scuta are usually relatively large and cover most of the abdomen (see, e.g., fig. 37A, B), but females of *Z. clandestinus*, *Z. moffetti,* and *Z. walcotti* have only a very short postepigastric scutum (figs. 8E, 14D, 102E), and their dorsal scutum is also relatively small, confined to the anteriormost part of the dorsum (figs. 1B, 8B, 14C, 102D; the males of these species are unfortunately unknown). There is also variation in the number of eyes, with some species having two eyes (*Z. clandestinus* and *Z. moffetti*, figs. 3B, 10B) and others having six (figs. 15D, 50E).

Zyngoonops species have very peculiar female genitalia. Externally, there is a prominent, well-developed scape (figs. 7B, 52E, 75E). The length of the scape varies from relatively short (*Z. moffetti* and *Z. redii*, figs. 13B, 22B) to very long (*Z. goedaerti* and *Z. rockoxi*, figs. 30D, 103F). In *Z. rockoxi*, the scape is as long as the postepigastric scutum and almost reaches the spinnerets (figs. 36C, 103F). Scapes of this length are unknown in other oonopid genera.

The internal genitalia of *Z. rockoxi*, *Z. goedaerti*, and *Z. walcotti* could not be examined due to the limited number of available specimens, but dissection of the other species of *Zyngoonops* revealed a highly complex and unique genital system. In most species, the postepigastric scutum forms a peculiar pouchlike structure (figs. 7E, 44F, 55, 56). The copulatory opening is usually situated in the ventral wall of the pouch (figs. 55, 56) and is consequently not visible externally. Exceptions are *Z. moffetti* and the pouchless species *Z. redii*. In these species, the ventral surface of the scape shows a small orifice that presumably serves as the copulatory opening (figs. 13B, C, 22D).

The copulatory opening leads into a long genital duct (figs. 23B, 55). The duct ascends along the posterior uterine sclerite and starts to coil (figs. 55, 64, 77E). In *Z. moffetti* the duct seems to form only one or two coils (fig. 13D–F), but in the other species the number of coils is substantial. The duct of *Z. beatriceae*, for example, has more than 20 tightly packed coils (fig. 43E); indeed, the duct is coiled up to such an extent that it almost resembles a ball of twine (fig. 43D). In all species there is a slitlike opening in the posterior sclerite (figs. 44B, 54A, 55); the genital duct presumably opens into the uterus via this slit.

The female genitalia of *Z. chambersi* were recently studied by Burger (2011, under the name *Zyngoonops* sp.). In his paper, Burger presented a detailed reconstruction of the internal genitalia, including the genital musculature (Burger, 2011: fig. 2). It must be noted, however, that the reconstruction is not entirely accurate. The straight and coiled parts of the duct are erroneously considered to be separate structures (they are called the "tube" and the "globular appendix," respectively).

Many oonopids have complex male palps (see, e.g., Grismado, 2010; Platnick et al., 2011), but the palpal morphology of *Zyngoonops* is very simple and uniform. In all species, the embolus is short and tube shaped, with a bent tip (figs. 70F, G, 71; see also Burger, 2011: fig. 4G). Accessory structures (such as conductors) are lacking, and neither the cymbium nor the proximal segments exhibit any kind of special modification (fig. 69E, F).

Males of *Zyngoonops* have elaborately modified endites (figs. 46B, 103B). The endites are enlarged and heavily sclerotized (fig. 104F), and they bear modified setae and various projections (figs. 25E, 57E). The shape and size of these projections are species specific, and the endites are thus of considerable diagnostic importance. The most remarkable projection is arguably the median projection. This structure varies enormously in length among *Zyngoonops* species (see, e.g., figs. 19C, 25B). In *Z. rockoxi* the median projections are extraordinarily long: they pass between the chelicerae (fig. 31A, E) and then loop upward and backward (fig.

31A, E, F) to end near the posterodorsal tip of the carapace (fig. 31A, C). When the spider is observed under a stereomicroscope, the median projections are clearly visible as two black, whiplike structures (fig. 103A, C).

The modified endites presumably play a role during copulation. Armored oonopids adopt a venter-to-venter mating position, and the male's prosoma is usually situated underneath the female's epigastric region (see, e.g., Burger, 2007; Burger and Carrera, 2011: figs. 1, 2; Harvey, 1987). Thus, the projections on the endites may interact with the female genitalia.

However, the exact function of the various projections is unclear. Burger (2011) suggested that the males of *Z. chambersi* insert their median projections into the female's pouch to establish a firm lock during copulation. The present study provides some support for this hypothesis, for it reveals a broad positive correlation between pouch development and median projection length: all species with a well-developed pouch (*Z. marki*, *Z. swammerdami*, *Z. beatriceae,* and *Z. chambersi*) have long median projections, whereas the pouchless species *Z. redii* has very short median projections that barely protrude above the surface of the endite (figs. 19C, F, 20). This pattern is consistent with Burger's hypothesis, but additional morphological and ethological studies are needed to confirm the proposed locking mechanism.

The function of the whiplike median projections of *Z. rockoxi* remains elusive. It is difficult to imagine how the male could insert its extremely long projections into the female genitalia while still retaining a venter-to-venter mating position. In this species, the median projections may serve a different function, but it is unclear what that might be.

Zyngoonops is closely related to the African genus *Antoonops* Fannes and Jocqué (2008) and the Neotropical genus *Coxapopha* Platnick (2000). The three genera constitute a distinctive group, here called the *Zyngoonops* group. The members of this group exhibit the following features: (1) The male endites are heavily modified. They are enlarged and have a peculiar shape, with a short median margin and a bulging posteromedian part (figs. 57C, 79C, 91C). The ventral surface is heavily sclerotized except for a diagonal band that runs parallel to the anterior margin (figs. 103B, 104F, 106H). There is a pocket in the median wall of the endite (figs. 20C, D, 80D, 92D); the anterior edge of the pocket continues into a projection (the median projection, mp; see, e.g., figs. 20D, 58D); the posterior edge of the pocket continues into a ventral groove that runs between the mp and the setae s1–3 (figs. 19C, 58D, 79D, F, 91E, 92D). (2) The male has a heavily sclerotized labium (figs. 104F, 106H). (3) The male carapace has extended anterolateral corners (figs. 24A, 32B). (4) In males, the pleural membrane forms a pair of flaplike structures (figs. 19A, D, 33E, 80E); these pleural flaps are much more heavily sclerotized than the rest of the pleural membrane (fig. 104F). (5) The embolus is tube shaped and much shorter than the bulb (figs. 70A, 84F, 90D, E). (6) Females lack a receptaculum; instead there is a narrow genital duct (figs. 23B, 87C, 94B). Given these unusual features, it seems highly likely that the *Zyngoonops* group is monophyletic.

The *Zyngoonops* group currently includes 18 species (10 in *Zyngoonops* and four each in *Antoonops* and *Coxapopha*). However, the number of species is bound to increase substantially in the future. Recent sorting activities have yielded more than 100 new species, most belonging to new genera (personal obs.; R. Ott, personal commun.). Furthermore, judging from the published descriptions, the oonopids *Kijabe paradoxa* Berland, *Xestaspis reimoseri* Fage, and *Xestaspis sertata* Simon may also belong to the *Zyngoonops* group. Berland's (1914) figure of the male mouthparts of *K. paradoxa* shows darkened endites with a lighter diagonal band, and Fage's (1938) drawings of *X. reimoseri* show modified and darkened endites, a short embolus, and a carapace with extended anterolateral corners. There are no published illustrations of *X. sertata*, but Simon (1907: 232) mentions "partes oris nigrae," and the well-preserved male specimen (MNHN AR 5777, examined) shows all the typical features of the *Zyngoonops* group (personal obs.). The Seychellian oonopid *Patri david* (Benoit, 1979) may also belong to the group, for the male has modified endites and extended anterolateral corners (Saaristo, 2001; Fannes, 2010a).

The group has a very wide distribution, occurring in Central and South America (Platnick, 2000; Ott and Brescovit, 2004) and in West, Central, and East Africa (Fannes and Jocqué, 2008; unpubl. data). The group appears to be absent from South Africa and Madagascar. In recent years, the spider fauna of these countries has been extensively sampled, yielding more than 10,000 oonopid specimens (see, e.g., Dippenaar-Schoeman and Craemer, 2000; Ubick and Griswold, 2011), but none of these specimens belong to the *Zyngoonops* group (personal obs.; D. Ubick, personal commun.).

The high diversity and wide distribution suggest an ancient origin for the *Zyngoonops* group. If the American-African disjunction is considered the result of a vicariance event, the minimum age of the group would be pushed back into the late Cretaceous, i.e., to the separation of South America and Africa some 100 million years ago (Pitman et al., 1993). Future studies will have to determine whether this estimate is accurate.

MATERIAL AND METHODS

Routine taxonomic methods follow Fannes (2010b). Automontage images were produced using CombineZP software (Alan Hadley) or Leica Application Suite software. Internal genitalia were studied after digestion with pancreatin (Álvarez-Padilla and Hormiga, 2008) or eye-lens cleaner (Frick et al., 2010). Measurements are given in millimeters unless noted otherwise. Maps were created with the Global Mapper of Discover Life. Localities that are very close together are not shown separately on the maps. The species descriptions mention only differences from the genus description. All new species names are nouns in the genitive case. The specimens of *Zyngoonops walcotti* have been deposited in the California Academy of Sciences (CAS, C. Griswold and D. Ubick), San Francisco; some specimens of *Z. chambersi*, *Z. swammerdami*, and *Z. marki* have been deposited in the Plant Protection Research Institute (PPRI, A. Dippenaar-Schoeman), Pretoria, South Africa; all other specimens are in the Royal Museum for Central Africa (MRAC, R. Jocqué), Tervuren, Belgium. Females were chosen as holotypes because they can most readily be identified to species (the identification of males often requires detailed study of the endites). The paratypes of *Z. redii*, *Z. rockoxi*, and *Z. goedaerti* are preserved on SEM stubs, as are some of the paratypes of *Z. moffetti*. High-resolution versions of the published images, many additional images, and a distribution map for each species, are available on the PBI website (http://research.amnh.org/oonopidae).

ABBREVIATIONS

The following abbreviations are used throughout the text and figures. Institutional abbreviations are given in the Acknowledgments.

ae	anterolateral extension of P2
ag	anterior group of setae
an	anterior edge of PES
ALE	anterior lateral eyes
ALS	anterior lateral spinnerets
ap	lateral apodeme
as	anterior sclerite
asp	anterior spiracle
bl	booklung
C	conductor
C.A.R.	Central African Republic
cd	coiled part of duct
ch	chelicera
d	duct
D.R.C.	Democratic Republic of Congo
DS	dorsal scutum
E	embolus
EN	endite
ES	epigastric scutum
la	labium
mp	median projection
MPT	most parsimonious tree
op	operculum
P	projection
p	pocket
Pb	projection b
PES	postepigastric scutum
pf	pleural flap
pg	posterior group of setae
PLE	posterior lateral eyes
PLS	posterior lateral spinnerets
PME	posterior median eyes
pmp	posteromedian part of endite

PMS	posterior median spinnerets
pou	genital pouch
ps	posterior sclerite
psp	posterior spiracle
Px	projection x
s	seta
sc	epigastric scape
sd	straight part of duct
so	slit sense organ
sp	sternal pouch
tb	transverse band
TL	total length

SYSTEMATICS

Zyngoonops Benoit

Zyngoonops Benoit, 1977: 246 (type species by monotypy *Zyngoonops clandestinus* Benoit).

DIAGNOSIS: *Zyngoonops* can be distinguished from all other oonopid genera by the following combination of features: dorsal and ventral scuta heavily sclerotized (figs. 37A, B, 103D); eyes relatively small (figs. 3B, 32A, 50E); sternum with two posterior prongs (figs. 3C–F, 33F, 34A, B, 102C); pedicel tube with a ventral lip (figs. 5D–F, 28B, 68E, F); postepigastric scutum with a prominent epigastric scape (figs. 7B, 22B, 52E).

DESCRIPTION: Total length of males 1.04–1.59, of females 1.15–1.53. **Cephalothorax:** Carapace yellow-orange, oval in dorsal view; pars cephalica usually moderately elevated, surface of elevated portion smooth, lower part of lateral surfaces with shallow microsculpture; thorax without depressions, without radiating rows of pits; posterolateral surface without spikes, posterolateral edge without pits; lateral margin straight, reborderered (e.g., figs. 2A–C, 65B–D, 104A–D, G, H); males with extended anterolateral corners (figs. 24A, 32B). Clypeus high, ALE separated from edge of carapace by their radius or more, median projection absent, setae present. Eyes: two (*Z. clandestinus*, *Z. moffetti*) or six (other species), small; ALE oval. Sternum longer than wide, yellow-orange, fused to carapace, median concavity absent, surface smooth, without pits, no clearly defined radial furrows, sickle-shaped structures absent, distance between coxae approximately equal, extensions of precoxal triangles present, without posterior hump, setae abundant, without hair tufts (figs. 65F, 103C); posterior margin with a pair of sclerotized prongs (e.g., figs. 3C–F, 33F, 34A, B, 102C); anterior margin protruding, in males with transverse band (e.g., figs. 25A, 32C, 66A). Males with a pair of pleural flaps (e.g., figs. 19A, 33E, 104F). Infracoxal grooves present, often with small pores (figs. 21C, 27A, B); coxal insertions I, II, and III each with two clusters of small openings. A row of 3–6 small openings on each side of the pedicel (e.g., figs. 2F, 3A, 74B, C). Chelicerae yellow-orange, straight, anterior face unmodified; at least in some species a small cheliceral tooth on promargin (fig. 45F); a short, apically pointed seta on inner surface of chelicera (figs. 4B, C, 11D); promargin flanked by double row of setae (inner and outer row), each row with about five setae, setae of inner row with small cuticular teeth on shaft, outer row consisting of smooth setae; between double row and fang base a long plumose hair; anterior face of paturon with sparse setae (figs. 4A, 11A, 24F); posterior surface of paturon with 2–3 short spines and a row of three long, medially directed setae (fig. 11B); fangs without toothlike projections, shape normal, without prominent basal process, tip unmodified. Labium: in males heavily sclerotized, much wider than long (figs. 25C, 104F); in females not heavily sclerotized, shape as in figures 4D, 74E. Male endites: enlarged, median margin short, posteromedian part bulging (e.g., figs. 19A, 57C); ventral surface heavily sclerotized except for diagonal band (figs. 103B, 104F); median surface with a pocket (e.g., fig. 20B–D) and two groups of setae (anterior and posterior group; fig. 58C); anterior edge of pocket continues into median projection (e.g., figs. 20D, 58D); median projection varying from very short (*Z. redii*; fig. 19C, F) to extremely long (*Z. rockoxi*; fig. 31A–C, E, F). Female endites: same as sternum in sclerotization, unmodified, with serrula present in single row (figs. 4E, F, 41E, F). Female palp without spines; femur twice as long as patella; patella as long as tibia, without prolateral row of ridges; tibia with three dorsal trichobothria, structure as on legs (fig. 5C); tarsus not expanded,

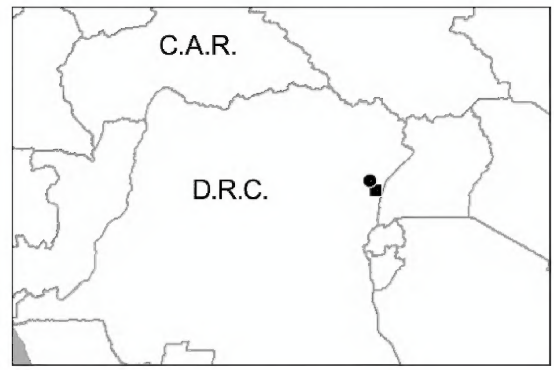
twice as long as tibia (figs. 5A, B, 11F, G); tarsal organ with two receptors (fig. 6E). Pedicel with one dorsal and one ventral sclerite; dorsal sclerite flat, posteriorly drawn out into a point, not fused to prosoma, without special modifications (figs. 3D, 10D); ventral sclerite U-shaped, covering ventral and lateral sides of pedicel, anteriorly fused to prosoma, without special modifications. **Abdomen:** Ovoid, without long posterior extension, rounded posteriorly, interscutal membrane rows of small sclerotized platelets absent (figs. 102A, D, E, 103D). Booklung covers ovoid, anterolateral edge unmodified, not covered with white, matted setae. Posterior spiracles not connected by groove (fig. 28C). Pedicel tube short, not ribbed, without triangular extensions, without fringe of setae; with ventral lip (figs. 5D–F, 28B, 68E, F), outer surface of lip covered by transverse, regularly spaced ridges (figs. 5E, 68F); scutopedicel region without ridges or denticles, plumose hairs absent, matted setae on anterior ventral abdomen in pedicel area absent. Two groups of small, rounded tubercles above pedicel tube (figs. 27D, 28A, 68D). DS strongly sclerotized, yellow-orange, without color pattern, middle surface smooth, sides smooth, anterior half without projecting denticles; in females short (*Z. clandestinus*, *Z. moffetti*, *Z. walcotti*) or long (other species). ES strongly sclerotized, yellow-orange, surrounding pedicel, not protruding, small lateral sclerites absent. PES strongly sclerotized, yellow-orange; in females short (*Z. clandestinus*, *Z. moffetti*, *Z. walcotti*) or long (other species). Often a pair of dark smooth regions mesad of anterior spiracles (fig. 28C, D); these regions are presumably muscle attachment marks. Lateral apodemes directed posteriorly (figs. 77A, B, 103D). Spinneret scutum present, incomplete ring, with fringe of needlelike setae (fig. 21F). Anal scutum present, usually weakly sclerotized. Supraanal scutum absent. Dense patch of setae anterior to spinnerets absent. Interscutal membrane with setae. Colulus small, sporting two setae (fig. 21F). ALS two segmented, with one major ampullate gland spigot and two piriform gland spigots (fig. 52B); PMS single segmented, with single spigot in males (fig. 49A), four spigots in females (fig. 52C); PLS two segmented, with two or three spigots in males (fig. 49B), six in females (figs. 7D, 52D). **Legs:** Yellow-orange, without color pattern, without spines; femur IV not thickened, same size as femora I–III, patella plus tibia I shorter than carapace. Tibiae III and IV with a group of specialized setae on ventral apex. Tarsal claws examined in detail in *Z. chambersi* (figs. 48C–E, 51B–D): superior claws I–II with 3–4 large, proximally situated teeth on lateral surfaces, about 10 small, distally situated teeth on median surfaces; superior claws III–IV with 2–4 large, proximally situated teeth on lateral surfaces, about 3 small, distally situated teeth on median surfaces; inferior claw absent. Trichobothria examined with SEM; each leg with four dorsal trichobothria: one on proximal tibia, two on distal tibia, one on distal metatarsus; hairs plumose, bothrium with ridges, aperture internal texture gratelike. Tarsal organ exposed, receptors as in figure 6A–D. **Genitalia:** Male epigastric region with sperm pore small, elliptical, wider than long, situated behind posterior spiracles (figs. 40D, 69C); a pair of additional orifices mesad of posterior spiracles (figs. 40D, 69C, D). Male palp not strongly sclerotized, proximal segments yellow, cymbium yellow or white; right and left palps symmetrical; trochanter unmodified; femur two or more times as long as trochanter, about twice as long as patella, attaching to patella basally; patella not enlarged, without prolateral row of ridges, setae unmodified; tibia about as long as patella, with three dorsal trichobothria; cymbium fused with bulb, but seam still visible distally, extending slightly beyond distal tip of bulb, with distal patch of setae, tarsal organ with two receptors; bulb white, elongated, shorter than cymbium; embolus tube shaped, its tip bent upward at an angle of almost 90° (figs. 29, 35C–F, 40E, F, 69E, F, 70, 71); no conductor or other accessory structures. Some specimens with a low ridge on the embolus (fig. 41A, B). Female genitalia consisting of an epigastric scape (figs. 7B, 22B, 52E), a genital duct and two uterine sclerites. Anterior uterine sclerite T-shaped (fig. 53B–D). Posterior uterine sclerite platelike; anterior surface with a slitlike opening distally (figs. 44A, B, 63A–C, 77C–E); sometimes a small, round opening more proximally (figs. 44C, 53F). Genital

duct narrow, ascending along posterior uterine sclerite (figs. 23B, 55, 63E, F, 64); distal part usually highly coiled (figs. 23E, 43D, E). Most species with a genital pouch that covers the posterior part of the duct (figs. 7E, 43B, 55). Copulatory opening usually situated in ventral wall of pouch (figs. 55, 56).

DISTRIBUTION: Known from the D.R.C. and the Central African Republic.

KEY TO SPECIES

1. Males (those of *Z. clandestinus*, *Z. moffetti,* and *Z. walcotti* unknown) 2
– Females 8
2. Median projections extremely long, ending near posterodorsal tip of carapace (figs. 31, 103A). . . . . *rockoxi*
– Median projections not extending beyond anterior margin of endites 3
3. Carapace posterodorsal part reclining (figs. 45B, 100D). 4
– Carapace posterodorsal part not reclining . . . 5
4. P2 with anterolateral extension (figs. 46E, F, 47C, 48A, B) . . . . . *chambersi*
– P2 without anterolateral extension (fig. 39A–D) . . . . . *beatriceae*
5. Median projections very short (figs. 19B, C, 20); P2 absent. . . . . *redii*
– Median projections longer; P2 present. . . 6
6. Median projections relatively long, robust (fig. 25B, E); P2 elongated (figs. 25B, E, 26A) . . . . . *goedaerti*
– Median projections shorter, more slender (figs. 57D, 66D, F); P2 platelike (figs. 57F, 58B, 67A, C) 7
7. Median projections short, thornlike (fig. 57D, E) . . . . . *swammerdami*
– Median projections longer, needlelike (fig. 66D, F) . . . . . *marki*
8. DS short, covering 1/3 or less of abdomen (figs. 8B, 14B, 102D); PES short (figs. 8E, 102E). 9
– DS long, covering nearly full length of abdomen (figs. 30B, 37B); PES long, most of ventral abdomen covered (figs. 21D, 30D, 42C). 11
9. Six eyes (fig. 15D). . . . . *walcotti*
– Two eyes (figs. 3B, 10B) 10
10. Epigastric scape relatively elongated, narrowed at tip (figs. 1F, 7B, 105A) *clandestinus*
– Epigastric scape relatively short, not narrowed at tip (figs. 8G, 13B, 105B) . . . . . *moffetti*
11. Epigastric scape very long, reaching posterior margin of PES (figs. 36C, 103F). . . *rockoxi*



Map 1. Records of *Zyngoonops clandestinus* (circle) and *Z. moffetti* (square).

– Epigastric scape not reaching posterior margin of PES 12
12. Epigastric scape 0.3 times as long as PES or shorter (figs. 21D, 61C, 75B) 13
– Epigastric scape 0.5 times as long as PES or longer (figs. 30D, 42C, 51E). 15
13. Epigastric scape tongue shaped (fig. 75E). . . . . *marki*
– Epigastric scape not tongue shaped. 14
14. Epigastric scape with posteriorly a shallow groove (fig. 22B). . . . . *redii*
– Epigastric scape without a groove (fig. 61D) . . . . . *swammerdami*
15. Epigastric scape triangular (figs. 30F, 105G). . . . . *goedaerti*
– Epigastric scape not triangular (figs. 42E, 52E). 16
16. Posterior half of scape much broader than anterior half (figs. 42E, 105E). . . *beatriceae*
– Posterior half of scape not much broader than anterior half (figs. 52E, 105D) . . . . *chambersi*

Zyngoonops clandestinus Benoit
Figures 1–7, 102, 105A; map 1

Zyngoonops clandestinus Benoit, 1977: 246, figs. 6–10 (female holotype from Visiki, Kivu, D.R.C., in MRAC; examined).

DIAGNOSIS: Females resemble those of *Z. moffetti* in having only two eyes (figs. 1C, 3B) and short dorsal and postepigastric scuta (fig. 102D, E) but differ in having a more elongated epigastric scape (figs. 1F, 7B, 105A).

MALE: Unknown.

FEMALE (figs. 1–7, 102, 105A): TL 1.52. Carapace length 0.59, width 0.45. Abdomen length 0.93, width 0.54. Habitus as in figure 102. Carapace microsculpture very shallow. Two small, round to oval eyes, approximately

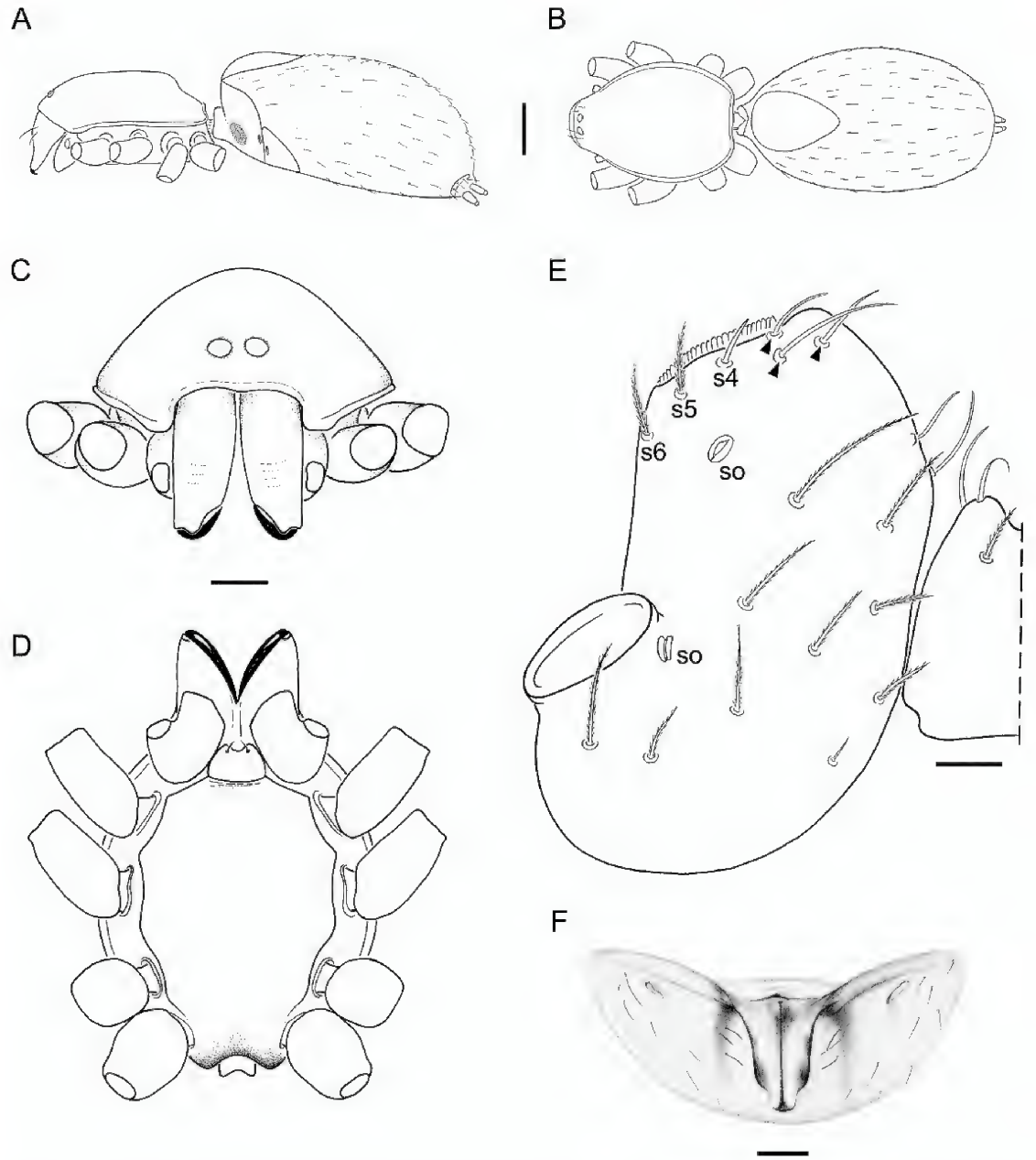


Fig. 1. *Zyngoonops clandestinus* Benoit, female. **A.** Habitus, lateral view. **B.** Same, dorsal view. **C.** Carapace, anterior view. **D.** Same, ventral view. **E.** Right endite, ventral view, showing setae 1–3 (arrowheads), setae 4–6 (s4–6) and slit sense organs (so). **F.** PES, ventral view. Scale bars: 15 μm (E), 40 μm (F), 90 μm (C, D), 200 μm (A, B).

one diameter apart (fig. 3B). Prongs as in figure 3C–F. Abdomen elongated ovoid. Booklung covers medium sized. Ventral lip constricted in the middle (fig. 5D). DS small, ovoid, covering only 1/4 of abdomen length (fig. 102D). PES short, leaving more than half of ventral abdomen uncovered (fig. 102E). Lateral apodemes of medium length. Epigastric scape narrowed at tip (figs. 1F, 7B, 105A). Internal genitalia as in

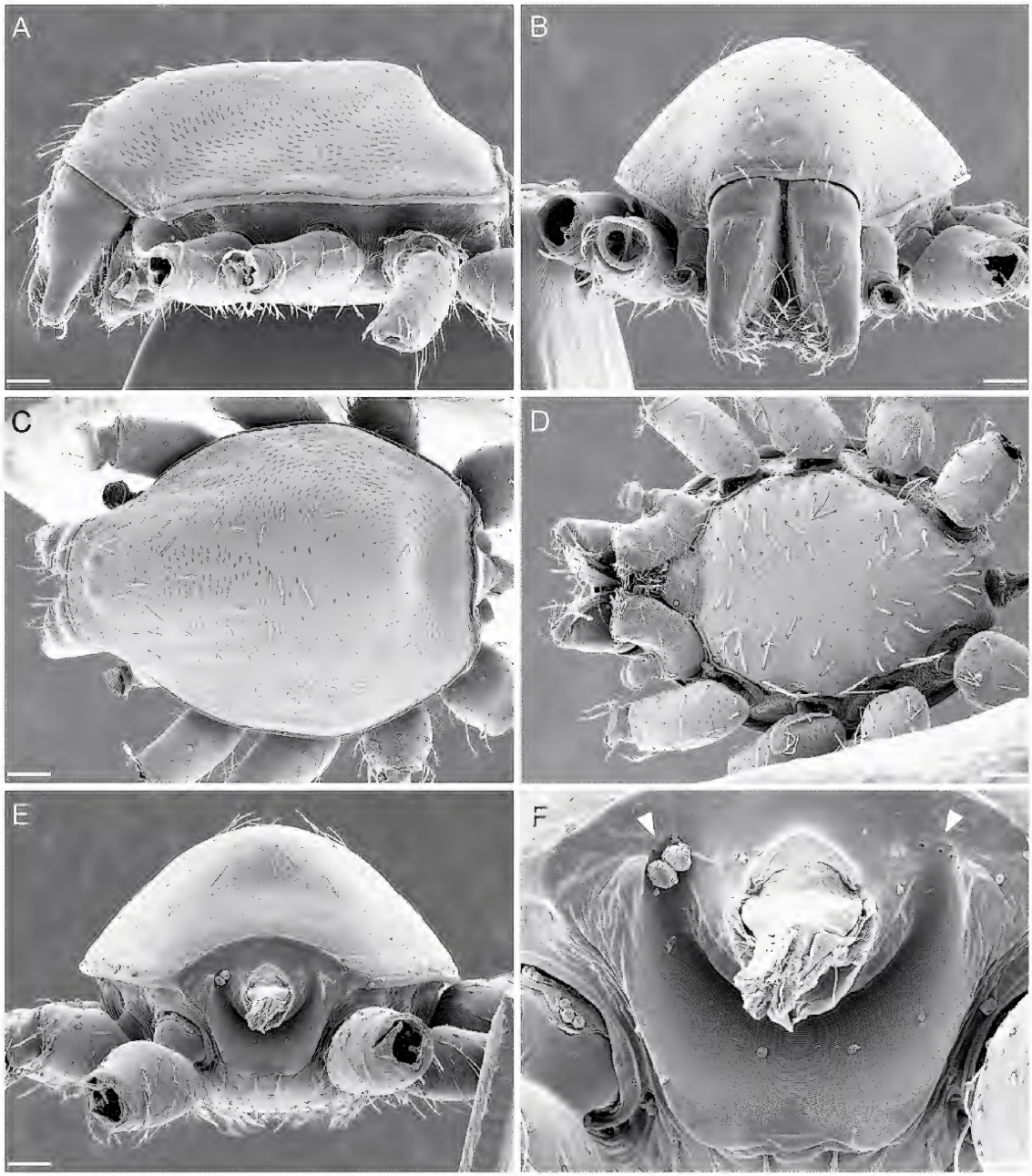


Fig. 2. *Zyngoonops clandestinus* Benoit, female, carapace. **A.** Lateral view. **B.** Anterior view. **C.** Dorsal view. **D.** Ventral view. **E.** Posterior view. **F.** Same, detail. Arrowheads: rows of small openings. Scale bars: 20 μm (F), 60 μm (A–E).

figure 7E, F. Genital pouch present (fig. 7E). Distal part of genital duct highly coiled (fig. 7E).

MATERIAL EXAMINED: **D.R.C.:** Kivu, Visiki forest, 00°21′N, 029°09′E, Dec. 22, 1971, Lejeune M. (PBI_OON 2191, MRAC 140.846), 1 female (holotype). Same data (PBI_OON 28773, MRAC 224.107), 1 female.

DISTRIBUTION: Known only from the type locality in the Kivu region, D.R.C. (map 1).

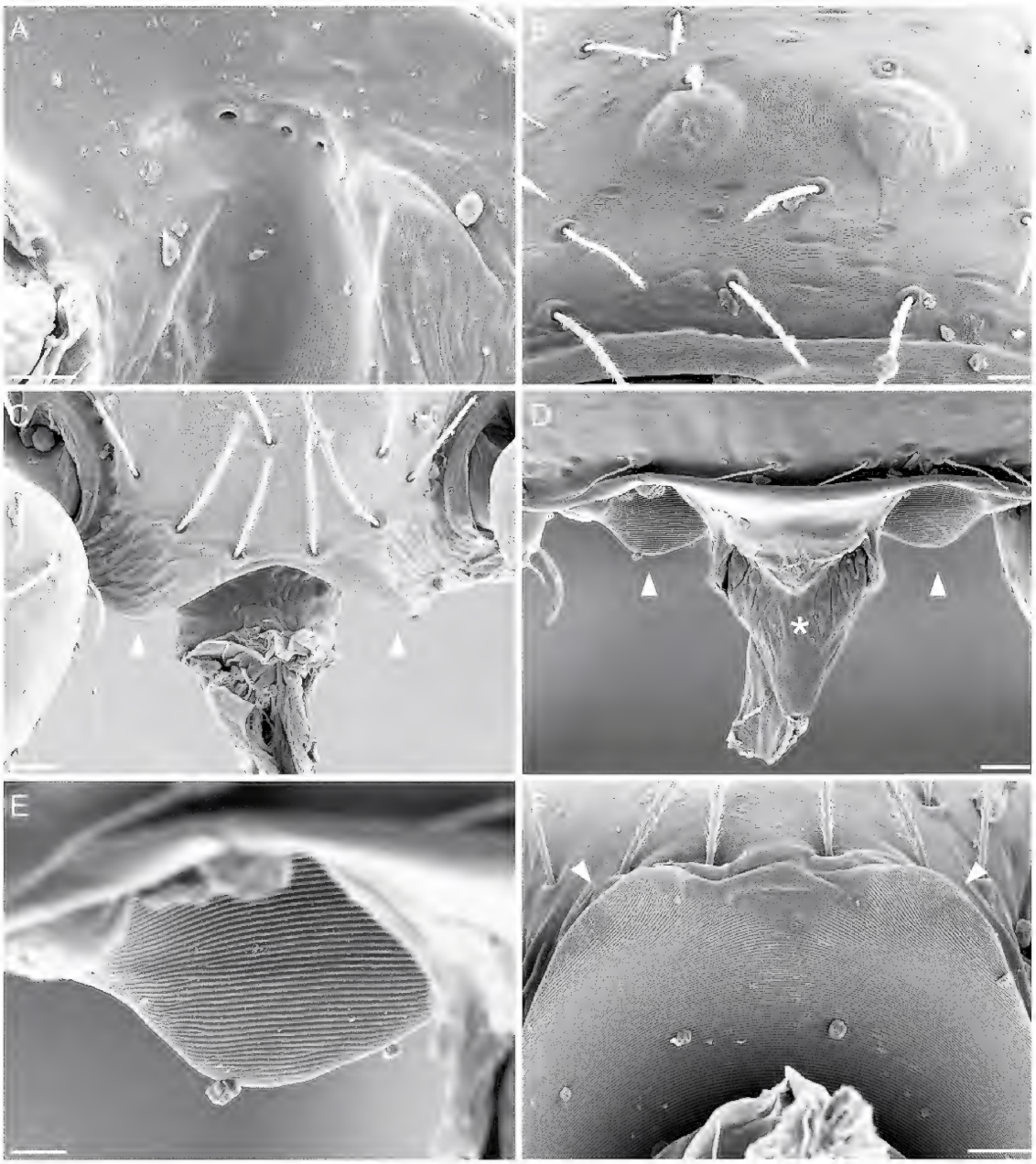


Fig. 3. *Zyngoonops clandestinus* Benoit, female. **A.** Detail of row of small openings. **B.** Eyes, anterior view. **C.** Sternal prongs (arrowheads), ventral view. **D.** Sternal prongs (arrowheads), dorsal view. Asterisk: dorsal pedicel sclerite. **E.** Same, detail of prong. **F.** Sternal prongs (arrowheads), posterior view. Scale bars: 5 μm (E), 10 μm (A, B), 15 μm (C, D, F).

Zyngoonops moffetti, new species
Figures 8–13, 105B; map 1

TYPES: Female holotype: D.R.C., Kivu, Mt. Lubwe SE de Butembo, 00°02′N, 029°18′E, April 13, 1971, dans bois mort, elev. 2380 m, Lejeune M. (PBI_OON 28853, MRAC 138.919). Paratypes: same data (PBI_OON 33808, MRAC 230.781), 3 females.

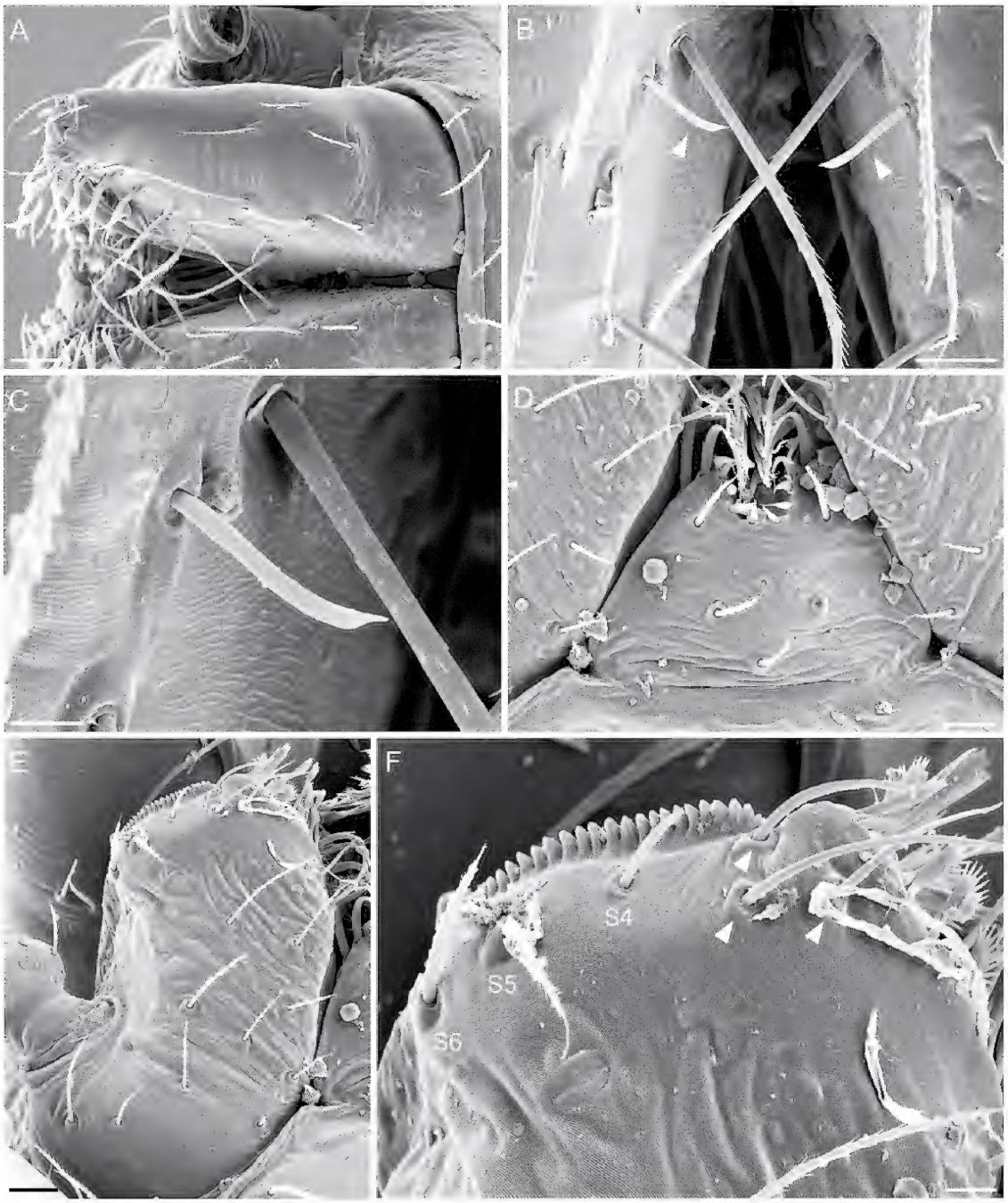


Fig. 4. *Zyngoonops clandestinus* Benoit, female. **A.** Chelicerae, anterior view. **B.** Same, detail, showing short, apically pointed setae (arrowheads). **C.** Same, detail of short, apically pointed seta. **D.** Labium, ventral view. **E.** Right endite, ventral view. **F.** Same, detail, showing setae 1–3 (arrowheads) and setae 4–6 (s4–6). Scale bars: 5 μm (C, F), 15 μm (B, D, E), 30 μm (A).

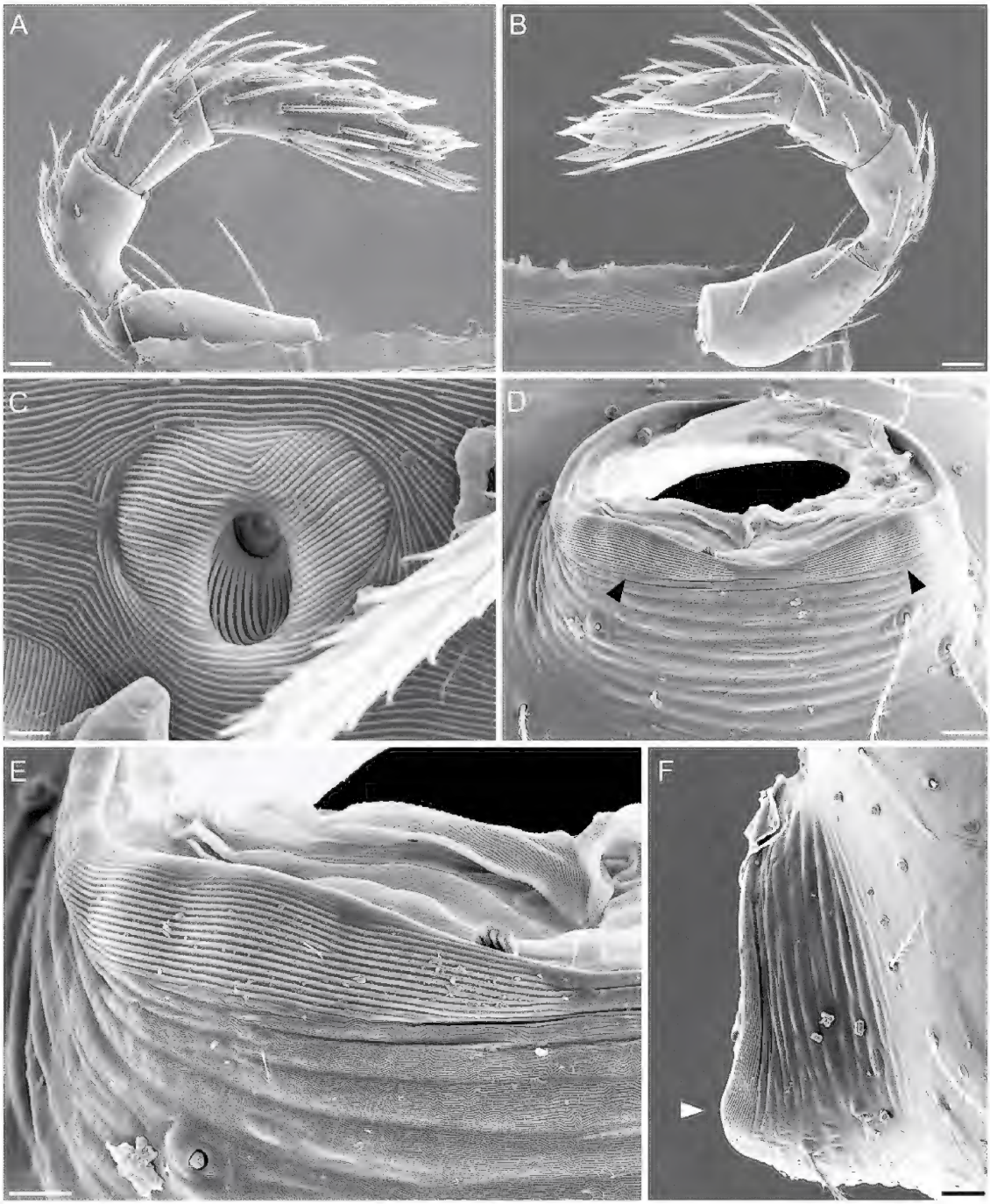


Fig. 5. *Zyngoonops clandestinus* Benoit, female. **A.** Pedipalp, prolateral view. **B.** Same, retrolateral view. **C.** Trichobothrial base from palpal tibia, dorsal view. **D.** Pedicel tube, ventral view. Arrowheads: ventral lip. Note that the lip is constricted medially. **E.** Same, detail of ventral lip. **F.** Pedicel tube, lateral view. Arrowhead: ventral lip. Scale bars: 1 μm (C), 5 μm (E), 10 μm (D, F), 25 μm (A, B).

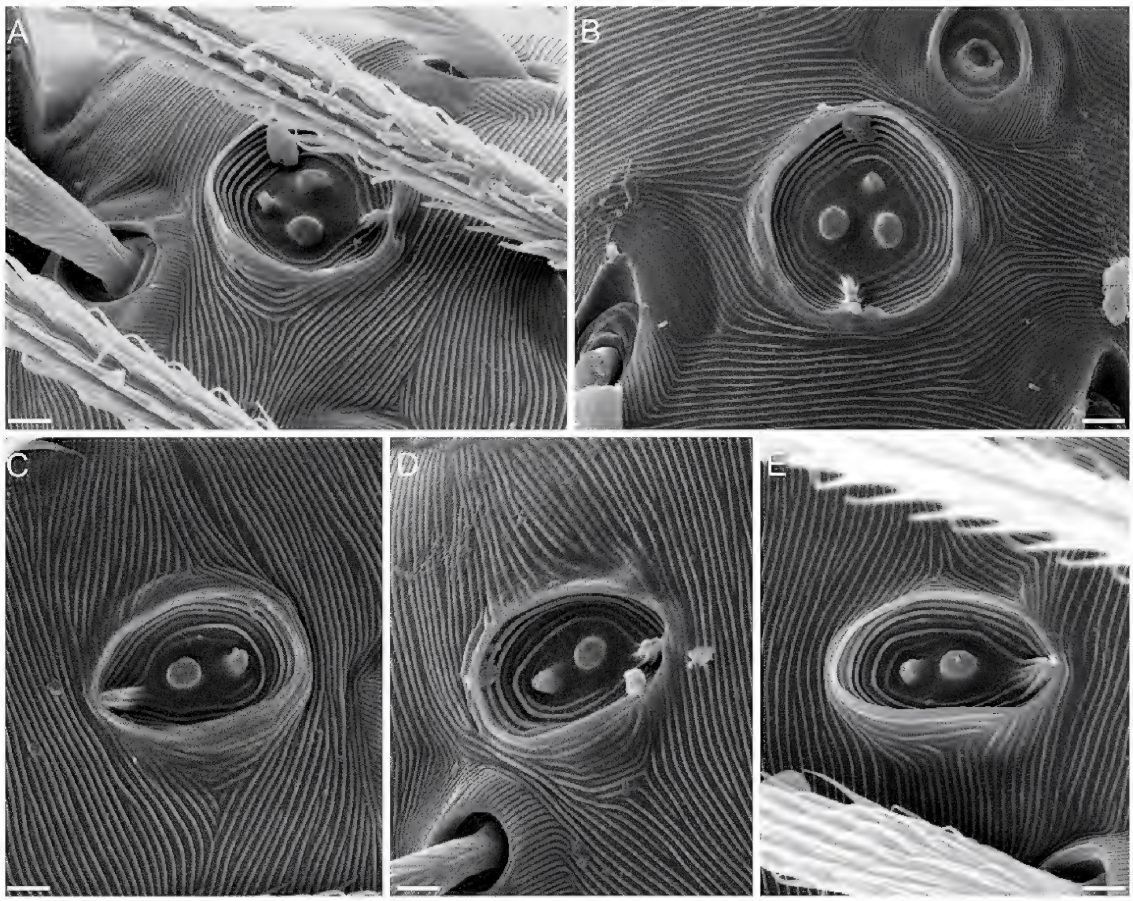


Fig. 6. *Zyngoonops clandestinus* Benoit, female, tarsal organs, dorsal view. **A.** Leg I. **B.** Leg II. **C.** Leg III. **D.** Leg IV. **E.** Pedipalp. Scale bars: 1 μm.

ETYMOLOGY: Named after the English naturalist Thomas Moffett (1553–1604), who wrote extensively on insects and spiders.

DIAGNOSIS: Females resemble those of *Z. clandestinus* but have a shorter epigastric scape (figs. 8G, 13B, C, 105B).

MALE: Unknown.

FEMALE (figs. 8–13, 105B): TL 1.40. Habitus as in figure 8A, B. Carapace microsculpture very shallow. Two small, round to oval eyes, less than one diameter apart (fig. 10B). Prongs as in figure 10C–F. Abdomen elongated ovoid. Booklung covers medium sized. Ventral lip as in figure 12A–C, with ridges weakly developed. DS small, ovoid, covering only 1/4 of abdomen length (fig. 8B). PES short, leaving more than half of ventral abdomen uncovered (fig. 8E). Lateral apodemes of medium length. Epigastric scape relatively short, with a small opening in the ventral surface (fig. 13B, C). Internal genitalia as in figure 13D–F. Genital pouch present (fig. 13D, E). Genital duct with apparently only one or two coils (fig. 13D–F).

OTHER MATERIAL EXAMINED: None.

DISTRIBUTION: Known only from the type locality in the Kivu region, D.R.C. (map 1).

Zyngoonops walcotti, new species
Figures 14–16, 105H; map 2

TYPE: Female holotype: Central African Republic, Prefecture Sangha-Mbaéré, Parc National Dzanga-Ndoki, Mabéa Bai, 21.4 km 53°NE Bayanga, 03°02′00″N, 16°24′36″E, May 1–7, 2001, rainforest, elev. 510 m, B.L. Fisher (PBI_OON 3481, CAS).

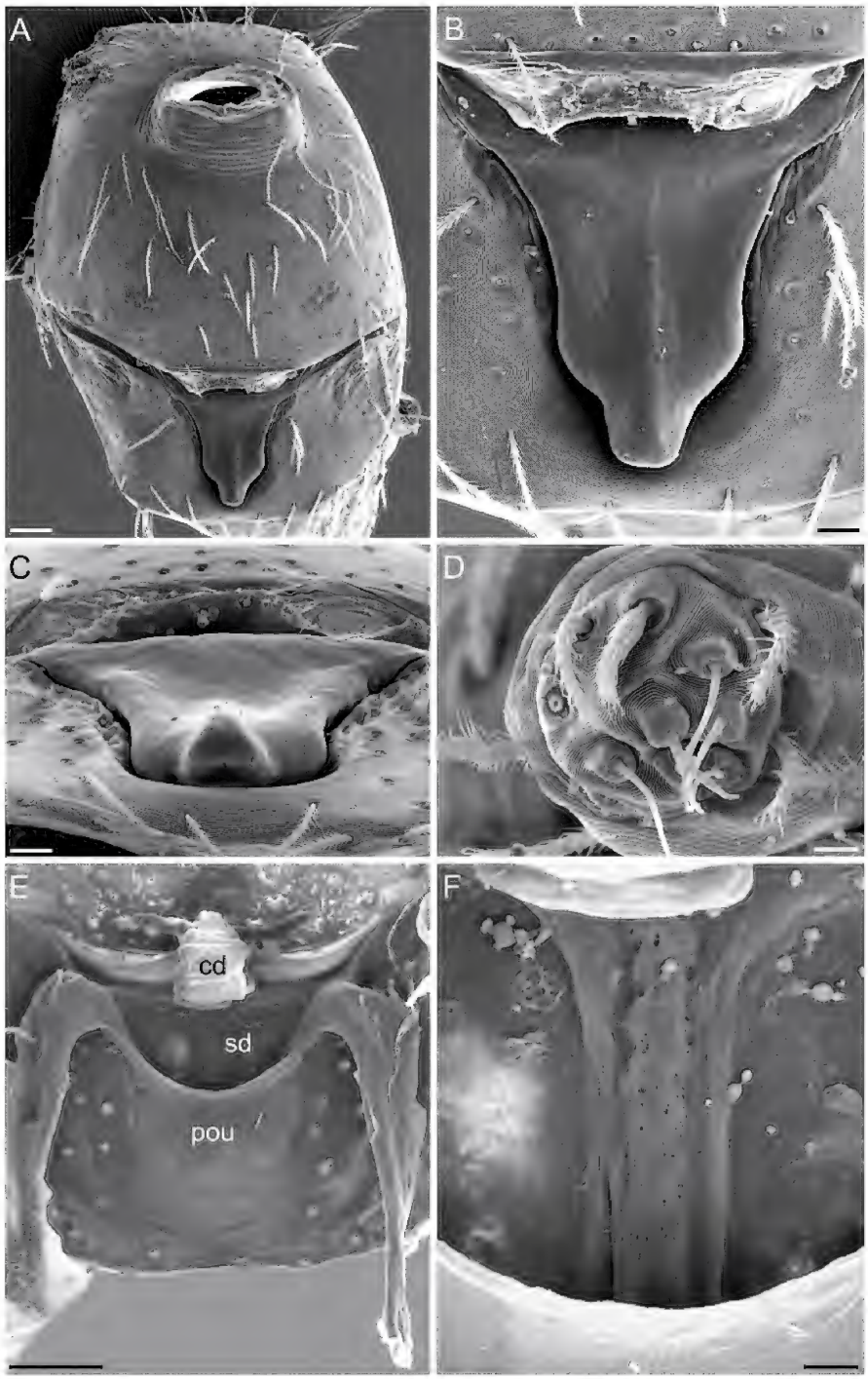
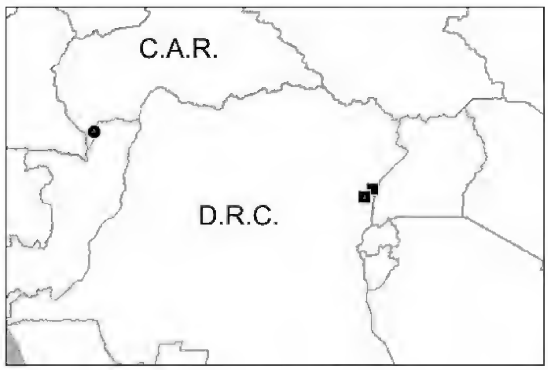
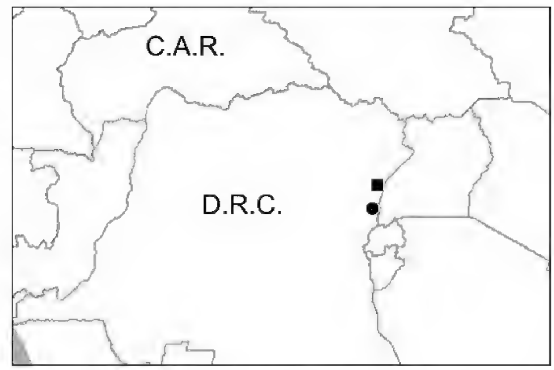


Fig. 7. *Zyngoonops clandestinus* Benoit, female. **A.** ES and PES, ventral view. **B.** Epigastric scape, ventral view. **C.** Same, posterior view. **D.** PLS, posterior view. **E.** Internal genitalia, dorsal view, showing pouch (pou), straight part of duct (sd) and coiled part of duct (cd). **F.** Same, detail of straight part of duct. Scale bars: 3 μm (D, F), 10 μm (B, C), 40 μm (A, E).



Map 2. Records of *Zyngoonops walcotti* (circle) and *Z. chambersi* (squares).



Map 3. Records of *Zyngoonops redii* (circle) and *Z. beatriceae* (square).

ETYMOLOGY: Named after the American palaeontologist Charles D. Walcott (1850–1927). Walcott discovered the Burgess Shale quarry and described many of the fossils found there.

DIAGNOSIS: Females resemble those of *Z. clandestinus* and *Z. moffetti* but have six eyes and a pointed epigastric scape (figs. 14F, 105H). The sternal prongs are less pronounced than in other *Zyngoonops* species (fig. 15E).

MALE: Unknown.

FEMALE (figs. 14–16, 105H): TL 1.20. Habitus as in figure 14A, B. Carapace microsculpture very shallow. Six eyes, ALE less than one diameter apart, PME oval, touching or almost touching, PLE well separated from PME (fig. 15D). Prongs weakly developed (fig. 15E). Abdomen elongated ovoid. Booklung covers medium sized. Posterior surface of paturon could not be examined. DS small, covering only 1/3 of abdomen length (fig. 14C). PES short, leaving more than half of ventral abdomen uncovered (fig. 14D). Lateral apodemes rather short. Epigastric scape as in figures 14F and 105H, almost as long as PES.

OTHER MATERIAL EXAMINED: one female taken with the holotype (abdomen missing; carapace used for SEM).

DISTRIBUTION: Known only from the type locality in Sangha-Mbaéré, Central African Republic (map 2).

NOTE: *Z. walcotti* is assigned to *Zyngoonops* with some hesitation. The sternal prongs are weakly developed compared to other *Zyngoonops* species (see fig. 15E). The genital anatomy and pedicel tube morphology of *Z. walcotti* could not be examined in detail.

***Zyngoonops redii*, new species**
Figures 17–23, 105C; map 3

TYPES: Female holotype: D.R.C., Kivu, plaine de la Ruindi, Bulemba, 00°38′S, 029°22′E, June 15, 1972, dans termitière, Lejeune M. (PBI_OON 33276, MRAC 230.583). Paratype: same data (PBI_OON 33277, MRAC 230.582), 1 male.

ETYMOLOGY: Named after the Italian scientist Francesco Redi (1626–1697). Redi was one of the first to cast doubt on the theory of spontaneous generation.

DIAGNOSIS: Males can be recognized by the very short median projection (figs. 19C, F, 20A, C–G). Females can be recognized by the short epigastric scape with a shallow groove (figs. 17D, 22B, C, 105C).

MALE (figs. 17B, 18–20): TL 1.28. Habitus as in figure 17B. Posterior half of carapace with three red stripes, one on dorsal surface and one on each lateral surface; the three stripes joining on the posterior surface of the carapace; each lateral stripe has a very short, downward-projecting sidebranch at the level of coxal insertion III. Six eyes; ALE less than one diameter apart; PME oval, touching or almost touching; PLE well separated from PME; posterior eye row more or less procurved in dorsal view. Prongs as in figure 18C, D, well developed. Endites with a median projection (mp) and a P1 projection; mp very short (figs. 19C, F, 20A, C–G); ventral surface of P1 slightly vaulted (figs. 19F, 20F, G).

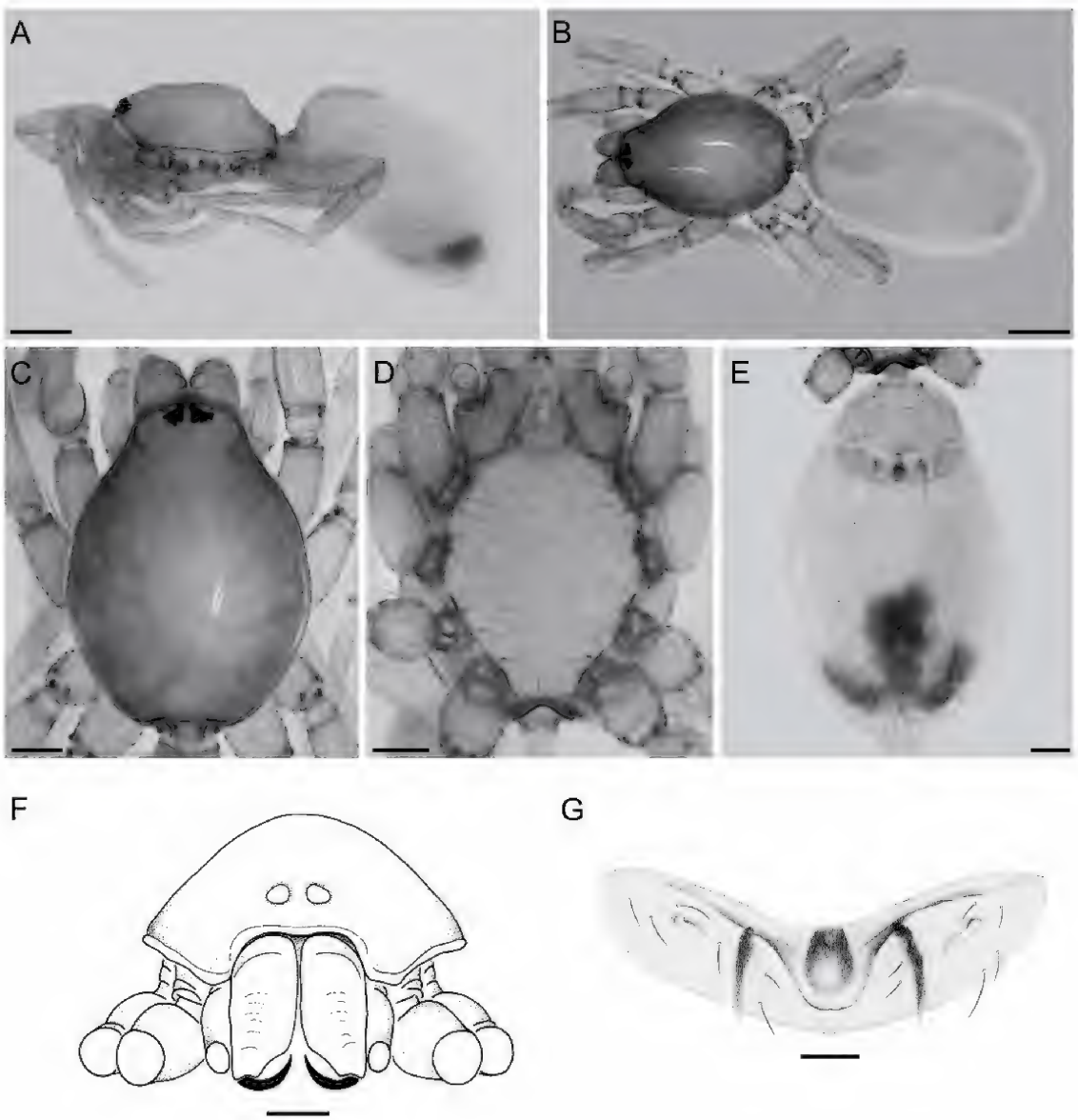
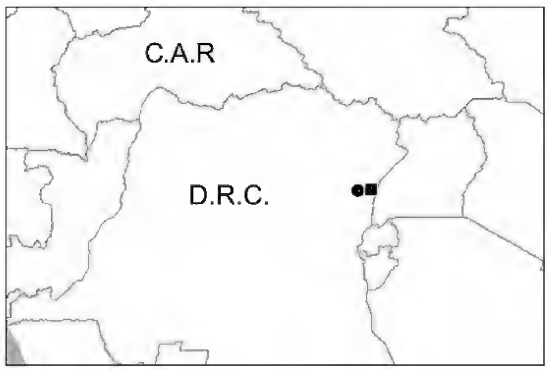


Fig. 8. *Zyngoonops moffetti*, new species, female. **A.** Habitus, lateral view. **B.** Same, dorsal view. **C.** Carapace, dorsal view. **D.** Same, ventral view. **E.** Abdomen, ventral view. **F.** Carapace, anterior view. **G.** PES, ventral view. Scale bars: 30 μm (G), 100 μm (C–F), 250 μm (A, B).

Booklung covers relatively small. Ventral lip not constricted. DS long, covering almost entire dorsum, fused to ES. PES fused to ES, forming single ventral scutum that covers nearly full length of abdomen (fig. 17B). Lateral apodemes very long, distally inward curved. PLS with two spigots.

FEMALE (figs. 17A, C, D, 21–23, 105C): TL 1.24. Habitus as in figure 17A. Carapace without stripes. Eyes as in male. Booklung covers relatively small. Ventral lip not constricted (fig. 21E). DS long, covering almost entire dorsum (fig. 17A). PES long, most of ventral abdomen covered (fig. 21D). Lateral apodemes very long. Epigastric scape short, triangular, with a shallow groove posteriorly (fig. 22B) that has a small round opening (fig. 22D). Internal genitalia as in



Map 4. Records of *Zyngoonops goedaerti* (circle) and *Z. swammerdami* (square).

figure 23. Genital pouch absent. Distal part of genital duct highly coiled (fig. 23B, E).

Other Material Examined: **D.R.C.:** Kivu, plaine de la Ruindi, Bulemba, 00°38′S, 029°22′E, June 20, 1972, dans termitière, Lejeune M. (PBI_OON 28694, MRAC 144.465), 2 females. Same data except date June 15, 1972 (PBI_OON 28667, MRAC 144.679), six females. Same locality, June 14, 1972, dans terreau, Lejeune M. (PBI_OON 28731, MRAC 224.184), 1 female. Kivu, vallée de Kaisola, Kabasha, plaine de la Ruindi, 00°38′S, 029°22′E, June 13, 1972, dans terreau, Lejeune M. (PBI_OON 28651, MRAC 144.559), 1 male.

Distribution: Known only from the Kivu region, D.R.C. (map 3).

Zyngoonops goedaerti, new species
Figures 24–30, 105G; map 4

Types: Female holotype: D.R.C., Kivu, terr. Lubero, Biambwe, 00°16′N, 028°57′E, July–August, 1967, dans humus, Celis M.J. (PBI_OON 28844, MRAC 136.725). Paratype: same data (PBI_OON 33813, MRAC 230.608), 1 male.

Etymology: Named after the Dutch painter and naturalist Johannes Goedaert (1617–1668). His book *Metamorphosis naturalis* (1662) includes one of the earliest scientific accounts of insect metamorphosis.

Diagnosis: The male can be recognized by the hornlike median projections (fig. 25B, E) and the narrow, elongated P2 projections (figs. 25E, 26A, D). Females can be recognized by the large, triangular epigastric scape (figs. 30F, 105G).

Male (figs. 24–29, 30E): TL 1.45. Habitus as in figures 24A, 27C. Carapace stripes as in *Z. redii*. Six eyes; ALE largest, PLE smallest; ALE approximately one diameter apart; PME round, not touching; PLE round, well separated from PME; posterior eye row slightly procurved in dorsal view. Prongs as in figure 24E. Endites with a median projection (mp), a P1 projection, a P2 projection, and three additional projections (Pa, Pb, Pc); mp robust, hornlike, directed anteriorly (fig. 25B, E); P1 situated very close to mp (figs. 25B, E, F, 26E, F); P2 situated anterior to seta s4, elongated, projecting toward tip of mp, anterior edge partly serrated, median surface strongly ribbed (figs. 25B, E, 26A, B, D); Pa situated anterior to P2, somewhat crestlike (figs. 25B, E, 26A, D); Pb situated posterior to P2, shape as in figures 25E and 26A, D; Pc a very small protrusion (fig. 25E). Booklung covers relatively small, lighter than surrounding scutum. Ventral lip not constricted. DS long, covering almost entire dorsum, fused to ES (fig. 27C, D). PES fused to ES, forming single ventral scutum that covers nearly full length of abdomen (fig. 27E). PLS with two spigots.

Female (figs. 30A–D, F, 105G): TL 1.38. Habitus as in figure 30A, B. Carapace without stripes. Eyes as in male. Booklung covers relatively small, lighter than surrounding scutum. DS long, covering almost entire dorsum (fig. 30B). PES long, most of ventral abdomen covered (fig. 30D). Lateral apodemes very long. Epigastric scape as in figures 30F and 105G, about half as long as PES.

Other Material Examined: None.

Distribution: Known only from the type locality in the Kivu region, D.R.C. (map 4).

Zyngoonops rockoxi, new species
Figures 31–36, 103; map 5

Types: Female holotype: D.R.C., Masako Forest, 00°35′N, 025°11′E, Dec. 14, 2007, primary forest, Jocqué R. and Juakaly J.-L. (PBI_OON 29108, MRAC 222.493). Paratype: same data (PBI_OON 29085, MRAC 222.494), 1 male.

Etymology: Named after the Flemish humanist Nicolaes Rockox (1560–1640). Rockox was a numismatist and archaeologist, as well as an important art collector and patron.

Diagnosis: Males can easily be recognized by the extremely long, whiplike median

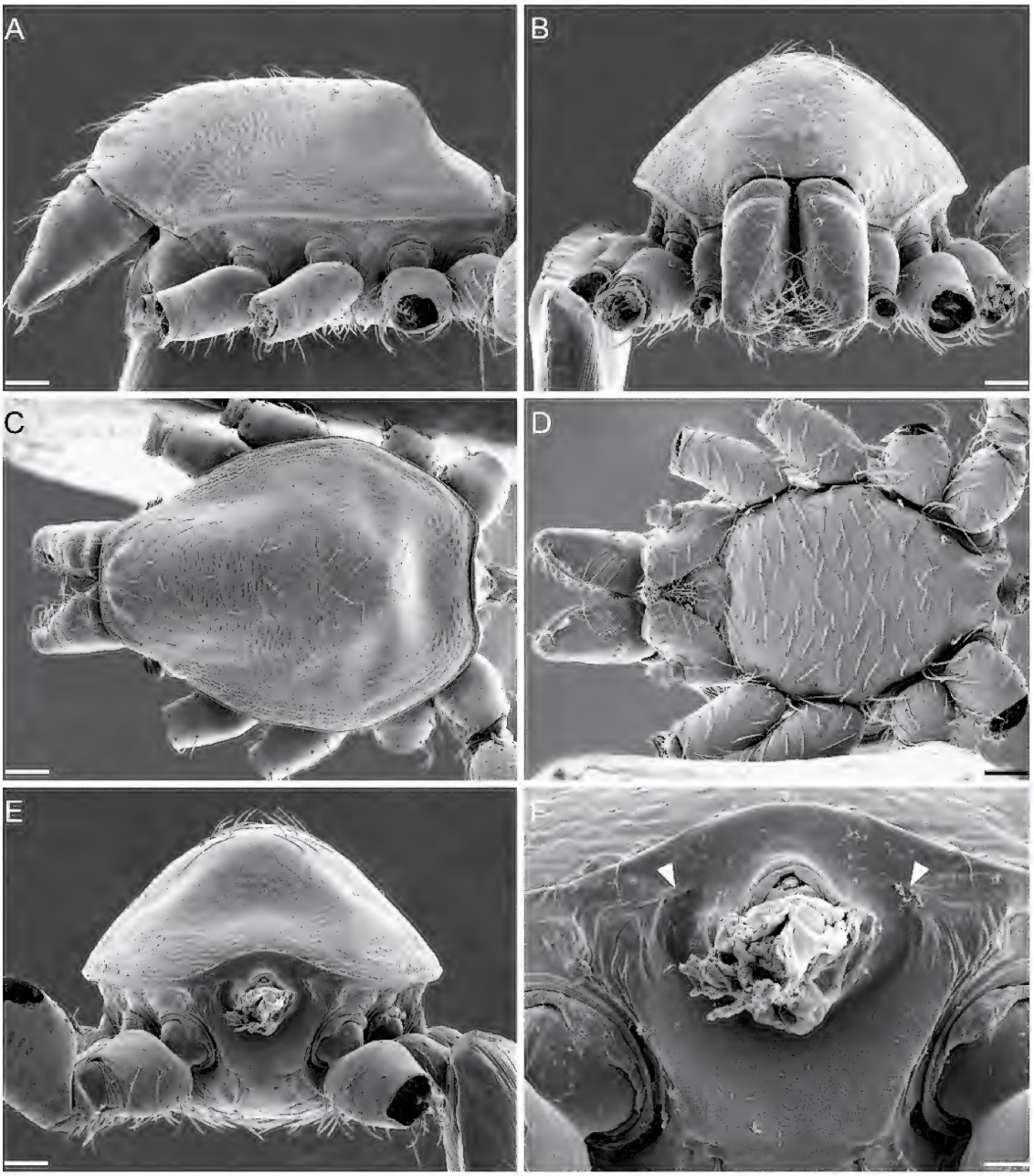


Fig. 9. *Zyngoonops moffetti*, new species, female, carapace. **A.** Lateral view. **B.** Anterior view. **C.** Dorsal view. **D.** Ventral view. **E.** Posterior view. **F.** Same, detail. Arrowheads: rows of small openings. Scale bars: 20 μm (F), 60 μm (A–E).

projections (figs. 31A–C, E, F, 103A–C), females by the very long epigastric scape that reaches the posterior margin of the PES (figs. 36C, D, 103F).

MALE (figs. 31–35, 103A–D): TL 1.04. Habitus as in figures 31A, 34C. Carapace: stripes as in *Z. beatriceae,* but dorsal stripe shorter; setae on dorsal midline directed posteriorly. Clypeus with many posteriorly directed setae (fig. 31F). Six eyes; ALE approximately one diameter apart; PME oval, almost touching; PLE well separated

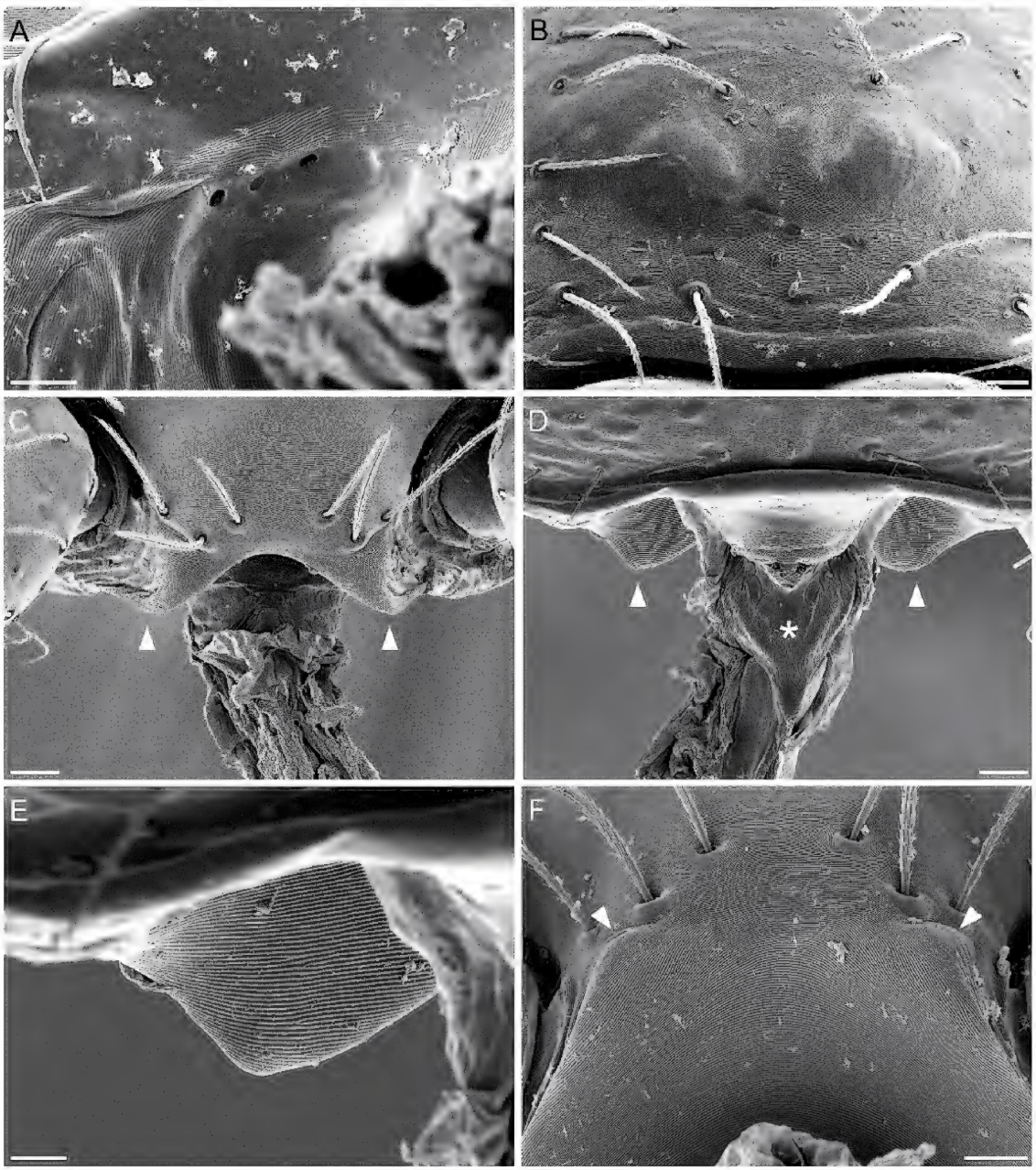


Fig. 10. *Zyngoonops moffetti*, new species, female. **A.** Detail of row of small openings. **B.** Eyes, anterior view. **C.** Sternal prongs (arrowheads), ventral view. **D.** Sternal prongs (arrowheads), dorsal view. Asterisk: dorsal pedicel sclerite. **E.** Same, detail of prong. **F.** Sternal prongs (arrowheads), posterior view. Scale bars: 5 μm (E), 10 μm (A, B), 15 μm (C, D, F).

from PME; posterior eye row strongly procurved. Endites with a median projection (mp), a P2 projection, and one additional projection (Px); mp directed anteriorly, extremely long, passing between the chelicerae (fig. 31A, E), then looping upward and backward (fig. 31A, E, F) to end near posterodorsal tip of carapace (fig. 31A, C); P2 situated anterior to seta s4, rather elongated, with anterior edge flattened into

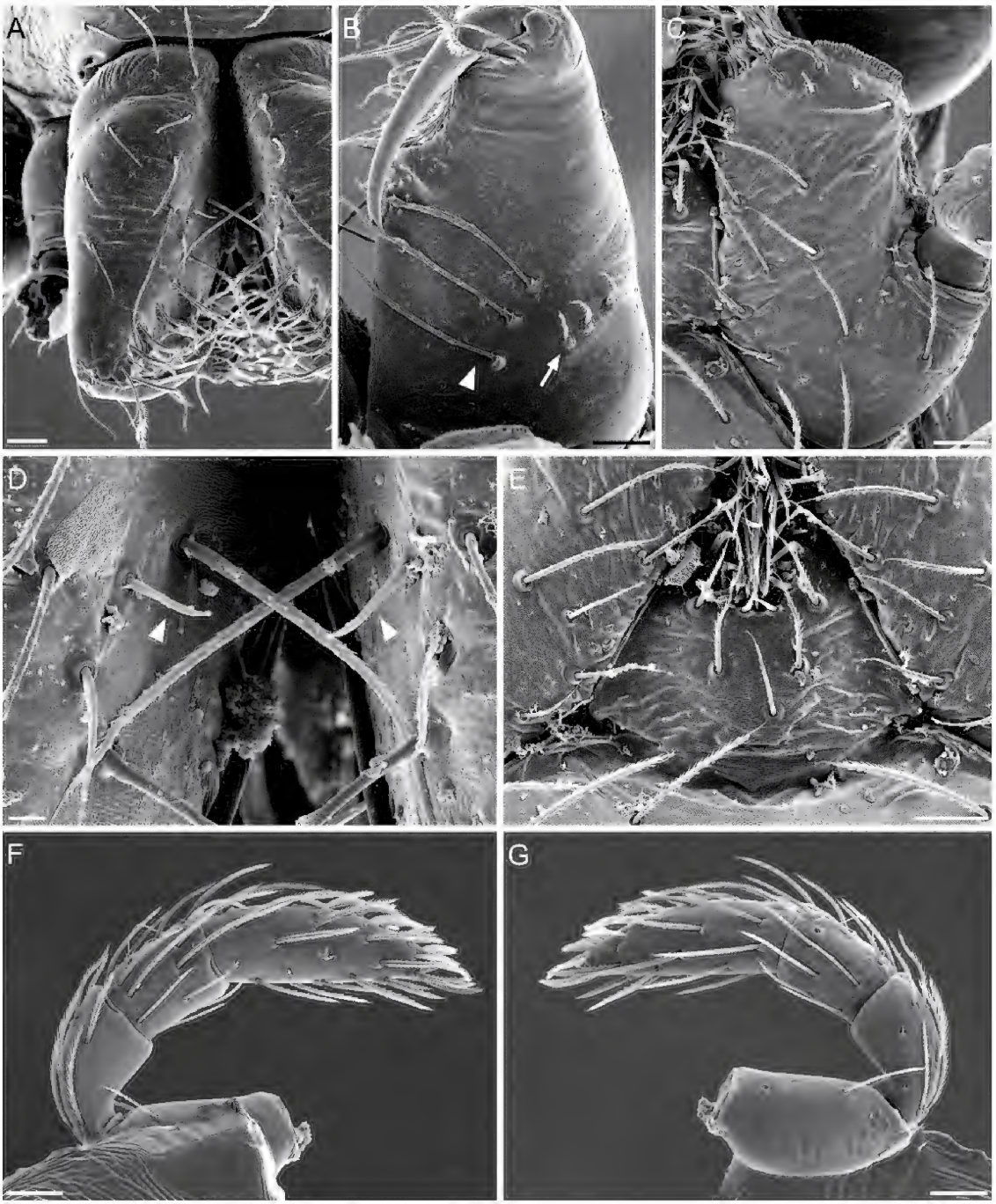


Fig. 11. *Zyngoonops moffetti*, new species, female. **A.** Chelicerae, anterior view. **B.** Left chelicera, posterior view, showing row of three long, medially directed setae (arrowhead) and group of shorter spines (arrow). **C.** Left endite, ventral view. **D.** Detail of A, showing short, apically pointed setae (arrowheads). **E.** Labium, ventral view. **F.** Pedipalp, prolateral view. **G.** Same, retrolateral view. Scale bars: 5 μm (D), 25 μm (A–C, E–G).

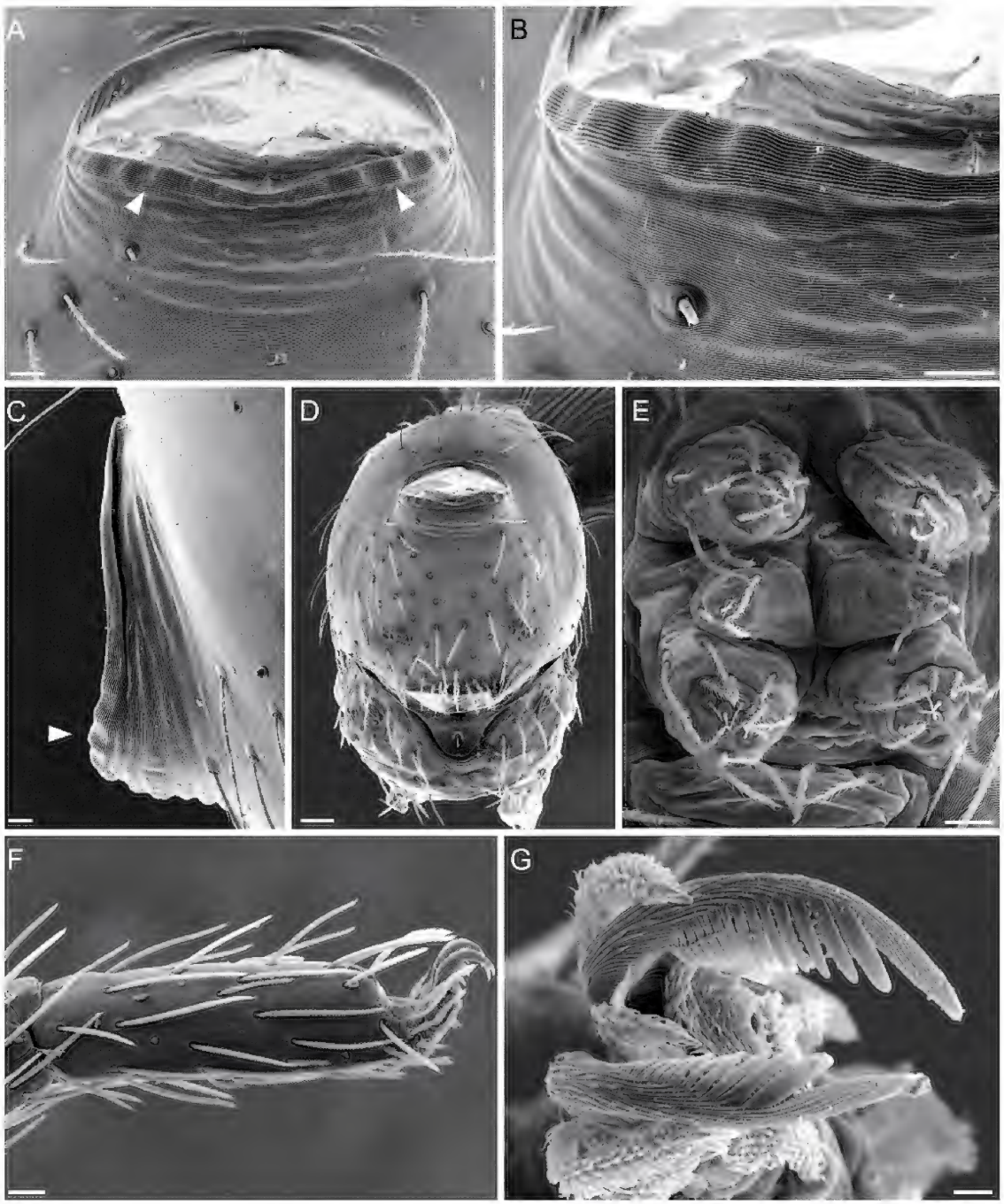


Fig. 12. *Zyngoonops moffetti*, new species, female. **A.** Pedicel tube, ventral view. Arrowheads: ventral lip. **B.** Same, detail of ventral lip. **C.** Pedicel tube, lateral view. Arrowhead: ventral lip. **D.** ES and PES, ventral view. **E.** Spinnerets, posterior view. **F.** Tarsus, leg II, lateral view. **G.** Claws, leg I, dorsal view. Scale bars: 2.5 μm (G), 10 μm (A–C, E, F), 30 μm (D).

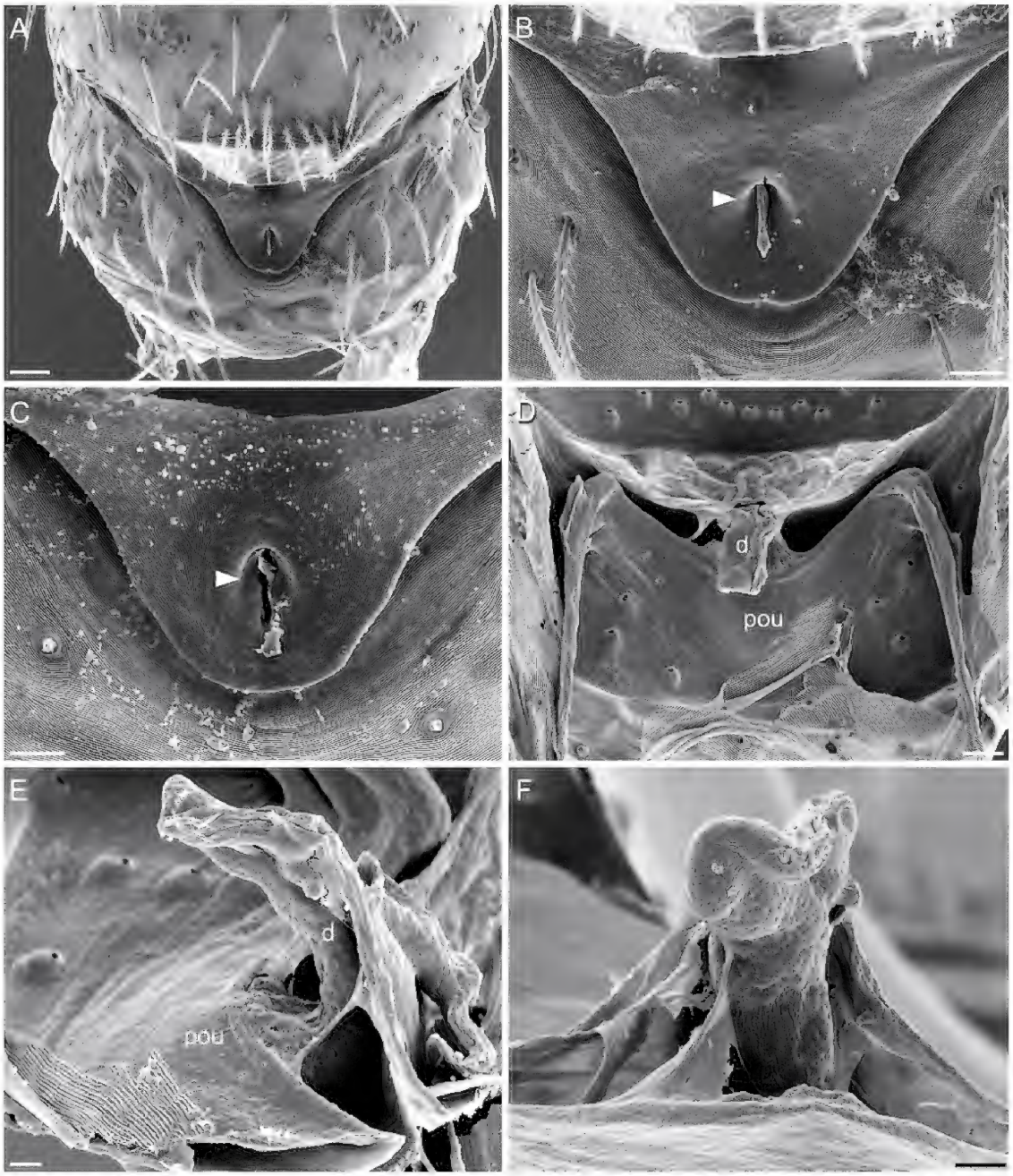


Fig. 13. *Zyngoonops moffetti*, new species, female. **A.** PES, ventral view. **B.** Epigastric scape, ventral view. Arrowhead: small opening. **C.** Same, other specimen. **D.** Internal genitalia, dorsal view, showing pouch (pou) and genital duct (d). **E.** Same, lateral view. **F.** Genital duct, posterior view. Scale bars: 5 μm (E, F), 10 μm (B–D), 20 μm (A).

narrow flange (figs. 32D, E, 33A, B); Px situated anterior to P2, crestlike (fig. 33B–D). Booklung covers medium sized. Ventral lip not constricted (fig. 35A). DS long, covering almost entire dorsum, fused to ES (fig. 34C, D). PES fused to ES, forming single ventral scutum that covers nearly full length of abdomen (fig. 34E). Lateral

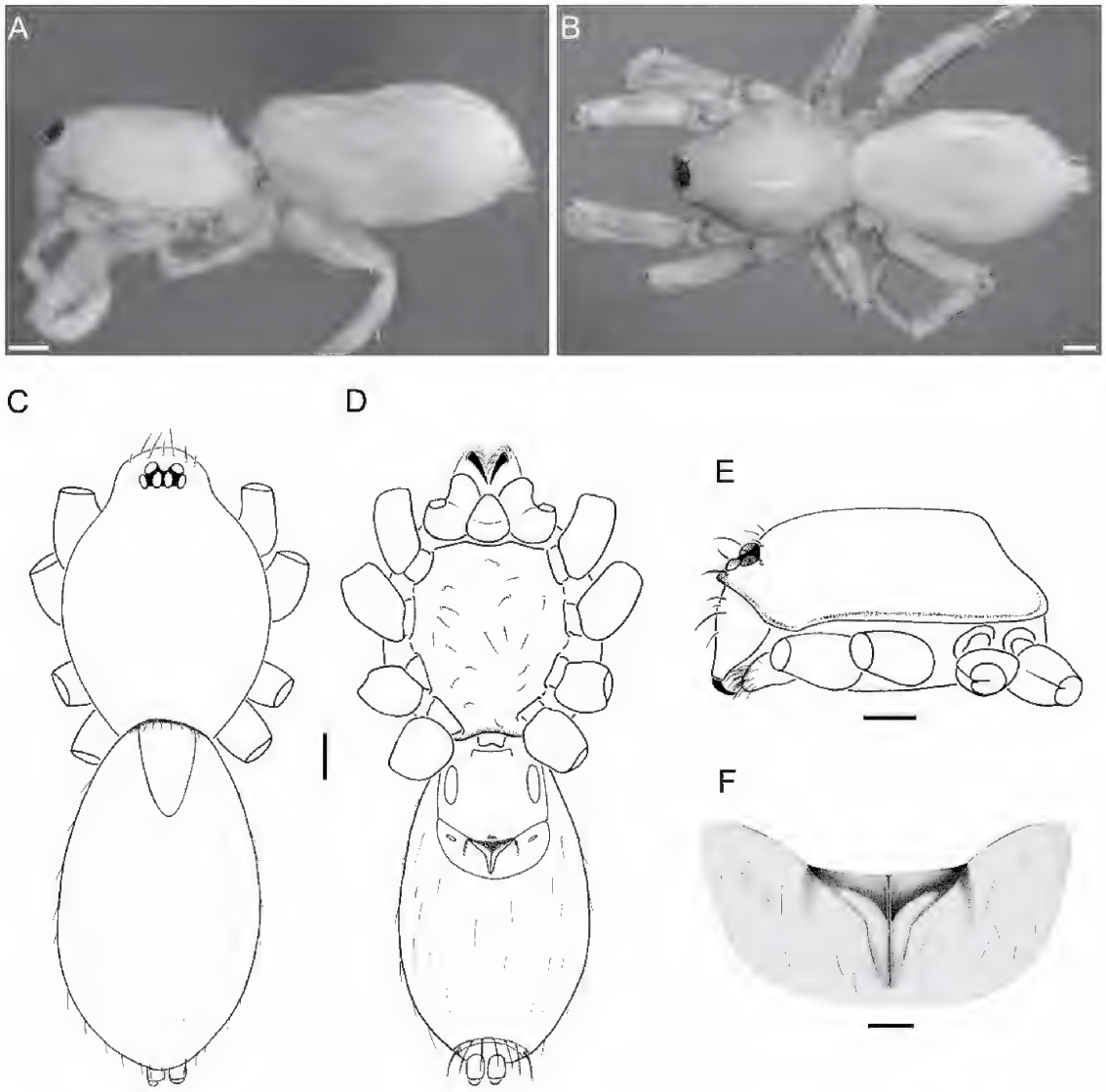


Fig. 14. *Zyngoonops walcotti*, new species, female. **A.** Habitus, lateral view. **B.** Same, dorsal view. **C.** Same. **D.** Same, ventral view. **E.** Carapace, lateral view. **F.** PES, ventral view. Scale bars: 30 μm (F), 100 μm (A–E).

apodemes very long (fig. 103D). PLS with three spigots.

FEMALE (figs. 36, 103E, F): TL 1.22. Habitus as in figure 36A, B. Carapace: on each lateral surface a short stripe at level of coxal insertion III (fig. 36A); most setae on dorsal midline directed anteriorly. Most clypeus setae directed anteriorly. Eyes as in male. Booklung covers relatively small. DS long, covering almost entire dorsum (fig. 103E). PES long, most of ventral abdomen covered (fig. 103F). Epigastric scape very long, reaching posterior margin of PES (figs. 36C, D, 103F).

OTHER MATERIAL EXAMINED: None.

DISTRIBUTION: Known only from the type locality in the Orientale province, D.R.C. (map 5).

***Zyngoonops beatriceae*, new species**
Figures 37–44, 105E, F; map 3

TYPES: Female holotype: D.R.C., Ruwenzori, Kibombole (R), Aug. 22, 1955, bambous,

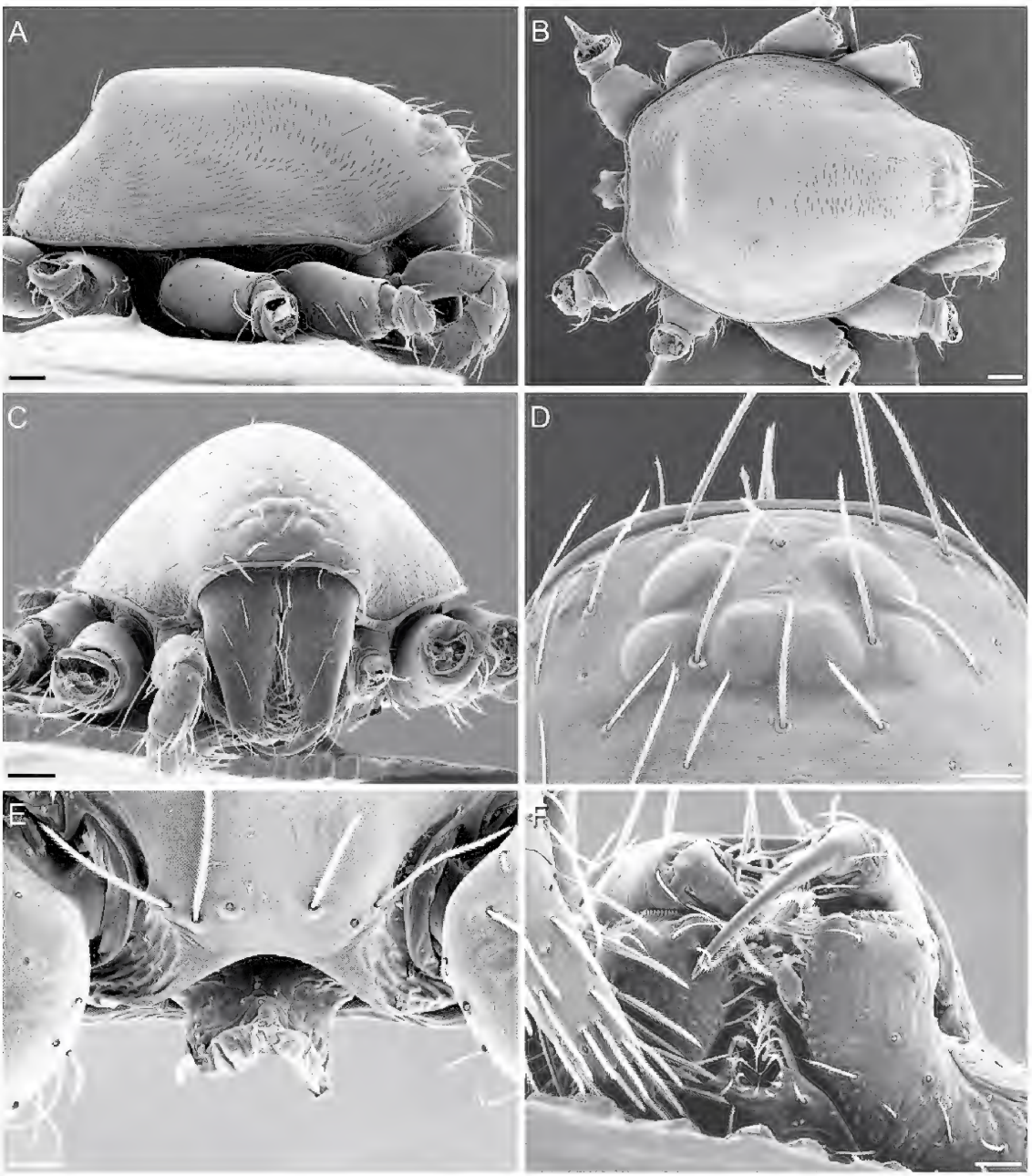


Fig. 15. *Zyngoonops walcotti*, new species, female. **A.** Carapace, lateral view. **B.** Same, dorsal view. **C.** Same, anterior view. **D.** Eyes, dorsal view. **E.** Sternal prongs, ventral view. **F.** Mouthparts, ventral view. Scale bars: 20 μm (D–F), 50 μm (A–C).

elev. 2700 m, Vanschuytbroeck P. (PBI_OON 33275, MRAC 230.390). Paratype: same data (PBI_OON 28506, MRAC 224.225), 1 male.

ETYMOLOGY: Named after the author's mother, Beatrice Coen.

DIAGNOSIS: Males resemble those of Z. *chambersi* but the P2 projection lacks an anterolateral extension (figs. 38F, 39A–D). Females can be recognized by the large, posteriorly rounded epigastric scape (figs. 37F, 42E, 105E).

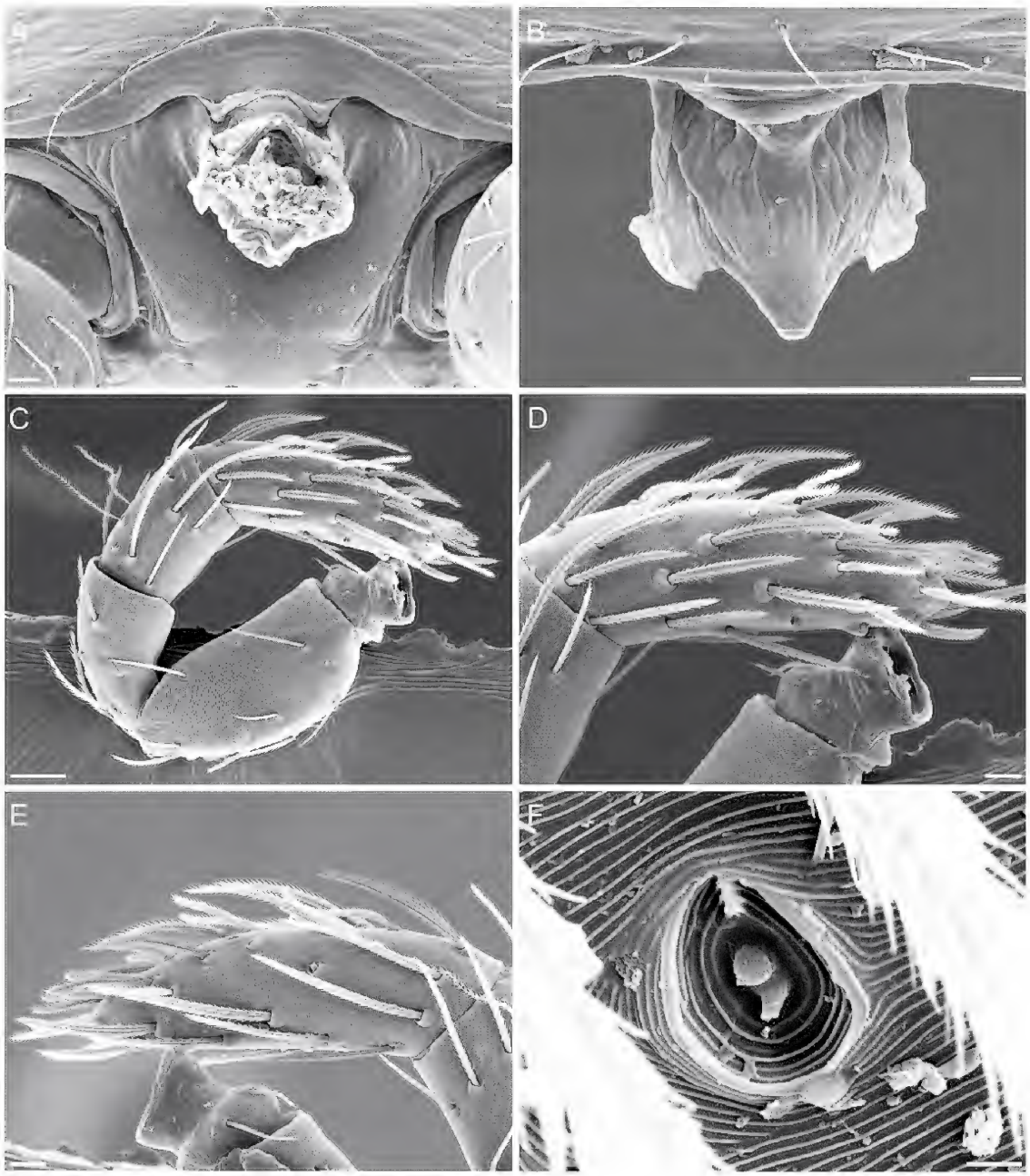
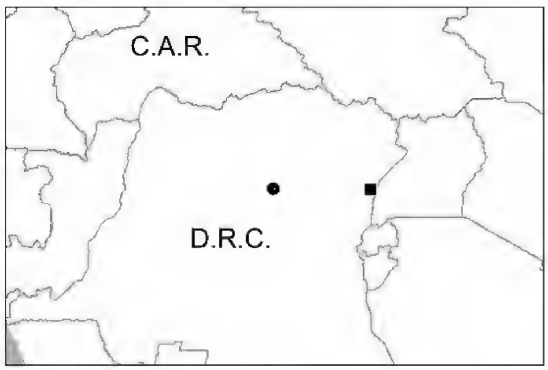


Fig. 16. *Zyngoonops walcotti*, new species, female. **A.** Carapace, region between coxae IV, posterior view. **B.** Dorsal pedicel sclerite, dorsal view. **C.** Pedipalp, prolateral view. **D.** Palpal tarsus, prolateral view. **E.** Same, retrolateral view. **F.** Palpal tarsal organ, dorsal view. Scale bars: 1 μm (F), 10 μm (A, B, D, E), 30 μm (C).

MALE (figs. 37A, C–E, 38–40, 41A, B): TL 1.59. Habitus as in figure 37A. Carapace strongly elevated in lateral view; posterodorsal part reclining (fig. 37A, C). Posterior half of carapace with three conspicuous red stripes, one on dorsal surface and one on each lateral surface; the three stripes joining on the posterior surface of the carapace; each



Map 5. Records of *Zyngoonops rockoxi* (circle) and *Z. marki* (square).

lateral stripe has a very short, downward-projecting sidebranch at the level of coxal insertion III; between each lateral stripe and dorsal stripe three much fainter, thinner stripes (upper, middle, and lower stripes; fig. 37C–E). Six eyes; ALE less than one diameter apart; PME oval, touching or almost touching; PLE round to oval, well separated from PME; posterior eye row straight or slightly procurved in dorsal view. Endites with five projections (mp, P2, P3, P4, P5); mp relatively long, directed anteriorly (fig. 39C); P2 large, relatively broad, somewhat platelike, shaft of seta 4 resting on surface of projection (figs. 38F, 39A, C–F, 40A); P3 cone shaped, relatively large (figs. 38F, 39B, D, F, 40A); P4 somewhat cone shaped, situated very close to P2 (fig. 39E, F); P5 crestlike, somewhat triangular (figs. 38F, 39D–F, 40A). Setae 1–3 long (fig. 39A). Booklung covers relatively small. Ventral lip not constricted (fig. 40C). DS long, covering almost entire dorsum, fused to ES (fig. 37A). PES fused to ES, forming single ventral scutum that covers nearly full length of abdomen (fig. 40B). PLS with three spigots.

FEMALE (figs. 37B, F, 41C–F, 42–44, 105E, F): TL 1.45. Habitus as in figure 37B. Carapace without stripes. Eyes as in male. Booklung covers medium sized. Ventral lip not

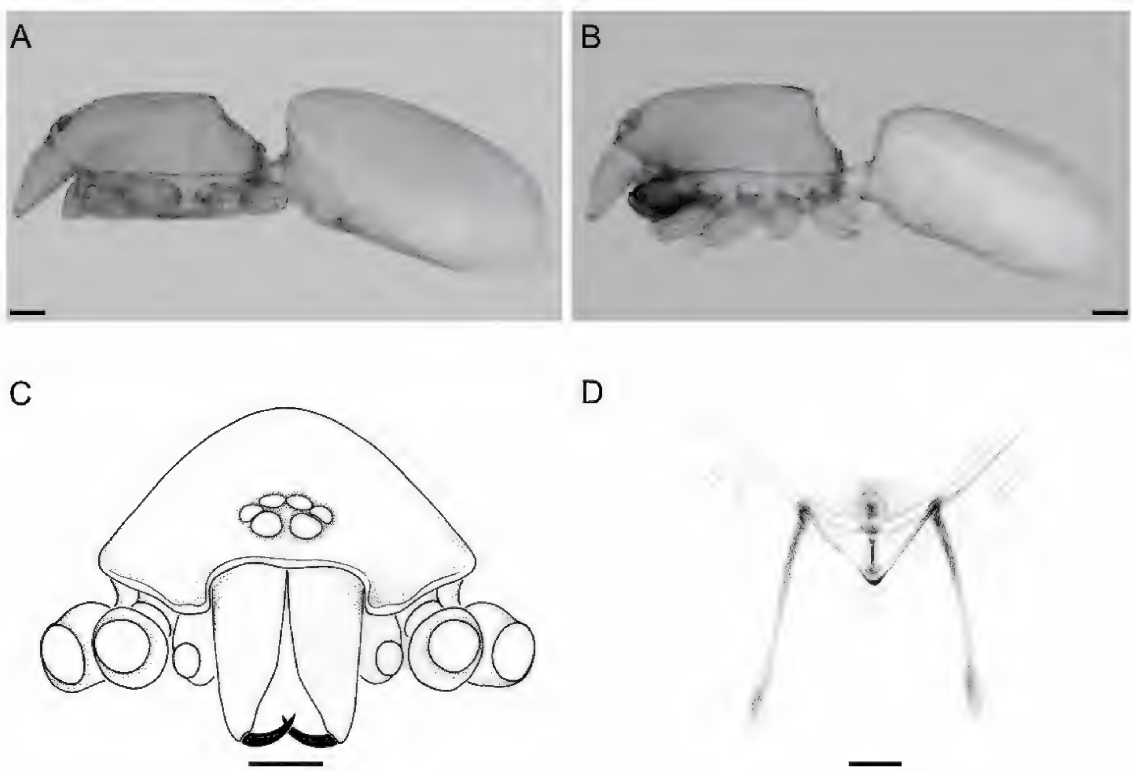


Fig. 17. *Zyngoonops redii*, new species, female (A, C, D) and male (B). **A, B.** Habitus, lateral view. **C.** Carapace, anterior view. **D.** Epigastric region, ventral view. Scale bars: 20 μm (D), 100 μm (A–C).

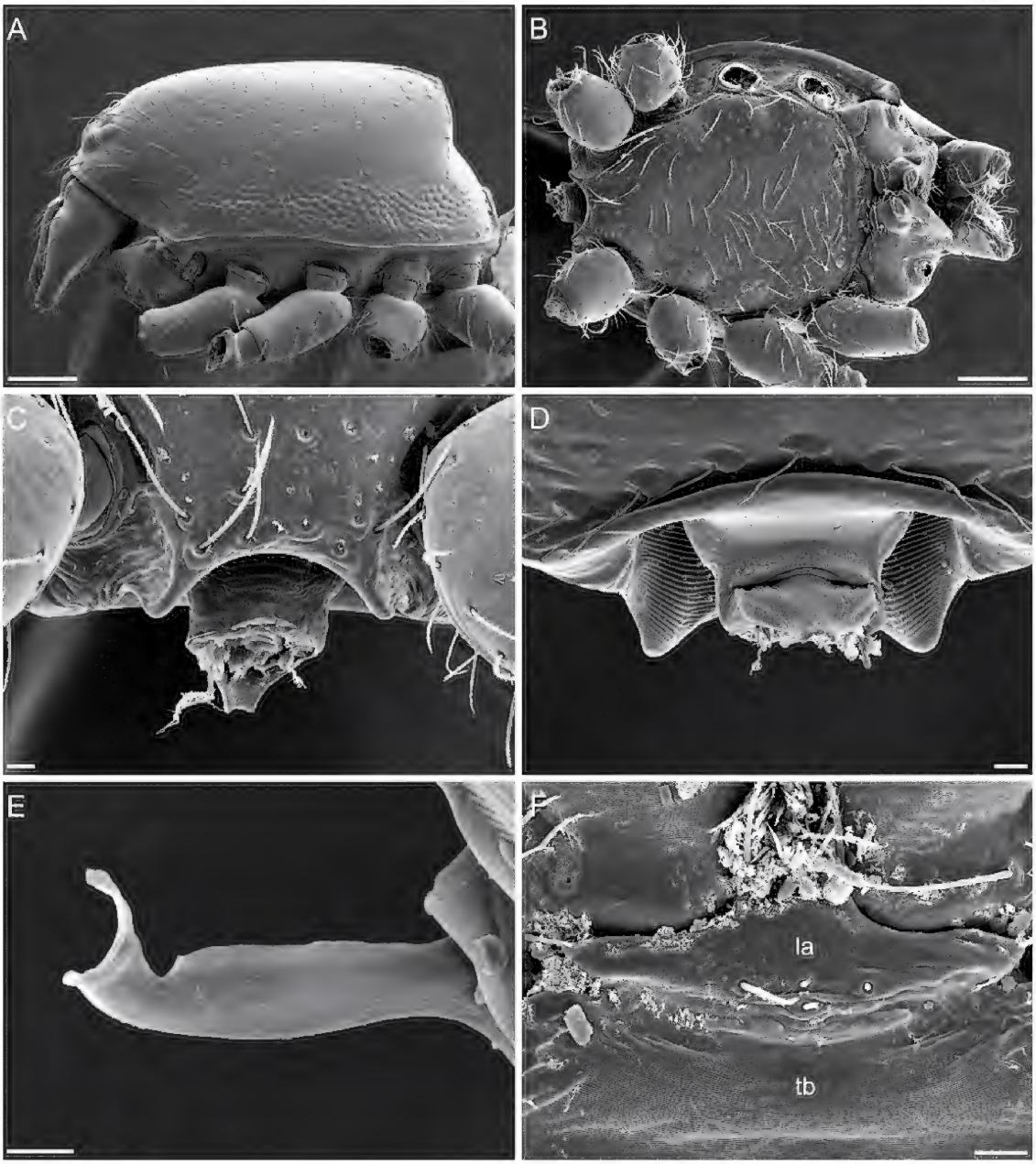


Fig. 18. *Zyngoonops redii*, new species, male. **A.** Carapace, lateral view. **B.** Same, ventral view. **C.** Sternal prongs, ventral view. **D.** Same, dorsal view. **E.** Embolus, prolateral view. **F.** Labium, ventral view. Abbreviations: **la,** labium; **tb,** transverse band. Scale bars: 10 μm (C–F), 100 μm (A, B).

constricted (fig. 42D). DS long, covering almost entire dorsum (fig. 37B). PES long, most of ventral abdomen covered (fig. 42C). Epigastric scape about half as long as PES, posteriorly rounded (figs. 37F, 42E, 105E). Internal genitalia as in figures 43, 44. Genital pouch present (figs. 43B, G, 44D, F). Distal part of genital duct highly coiled (figs. 43D, E, 44A, E).

OTHER MATERIAL EXAMINED: **D.R.C.:** Ruwenzori, Kibombole (R), Aug. 22, 1955, bambous, Berlèse, elev. 2700 m, Vanschuytbroeck P. (PBI_OON 28554, MRAC 224.216), 2 females.

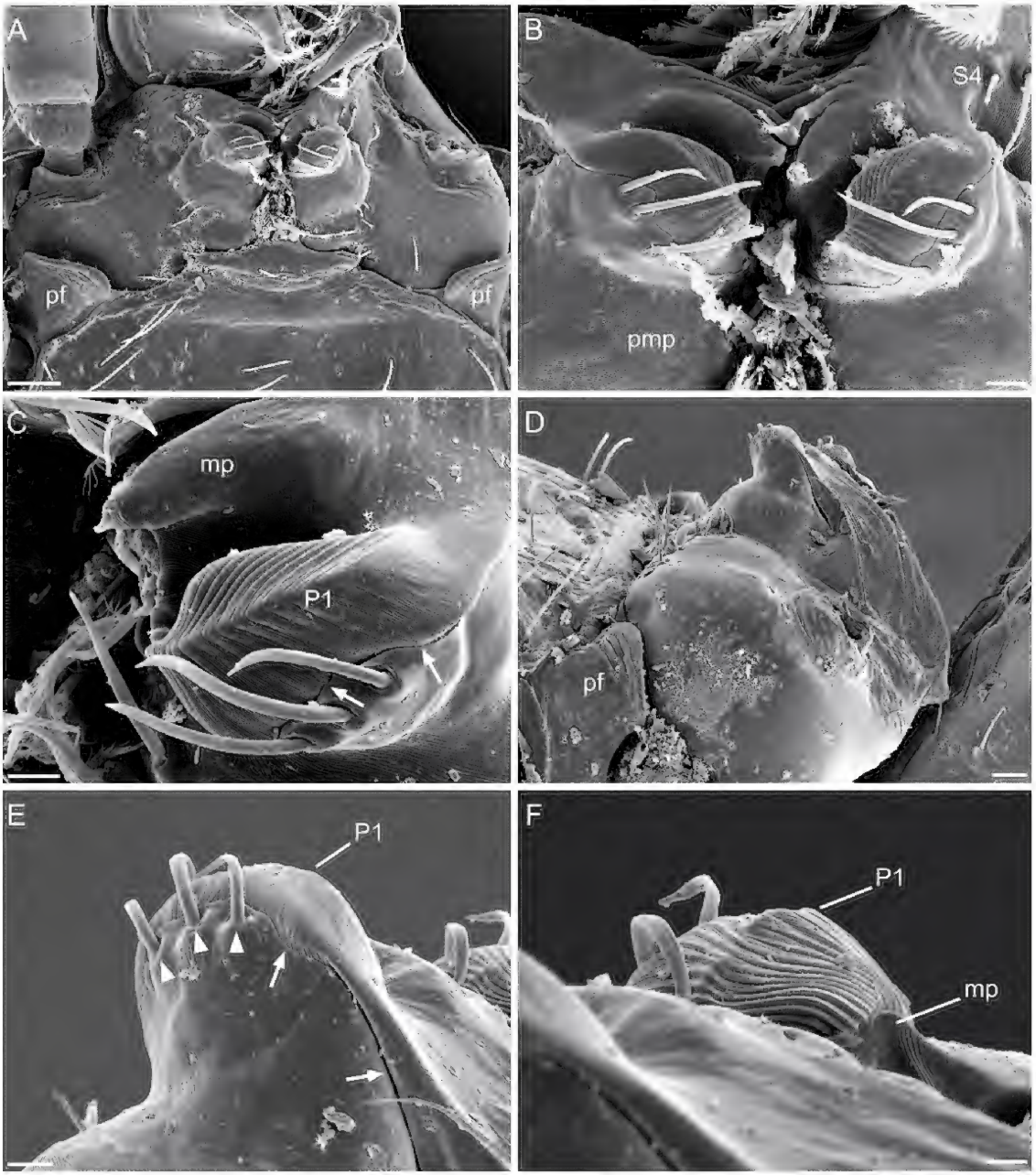


Fig. 19. *Zyngoonops redii*, new species, male. **A.** Mouthparts, ventral view. **B.** Detail of A, showing median part of endites. **C.** Other specimen, median part of left endite, ventral view. Arrows: groove. **D.** Endites, lateral view. **E.** Detail of D, showing setae 1–3 (arrowheads) and P1 of left endite. Arrows: groove. **F.** Detail of D, showing P1 and mp of right endite. Abbreviations: **mp,** median projection; **P,** projection; **pf,** pleural flap; **pmp,** posteromedian part of endite; **s,** seta. Scale bars: 3 µm (F), 5 µm (B, C, E), 15 µm (A, D).

Same data (PBI_OON 28526, MRAC 224.218), 1 female. Same data (PBI_OON 28600, MRAC 224.220), 1 male. Same data (PBI_OON 28586, MRAC 224.222), 1 female. Ruwenzori, ruiss. Karambura affl. dr. Katauleko, près Kalonge, 00°20′N, 029°48′E, Jan. 30, 1953, elev. 2060 m, Vanschuytbroeck P. and Kekenbosch J. (PBI_OON 28589, MRAC 224.217), 1 female.

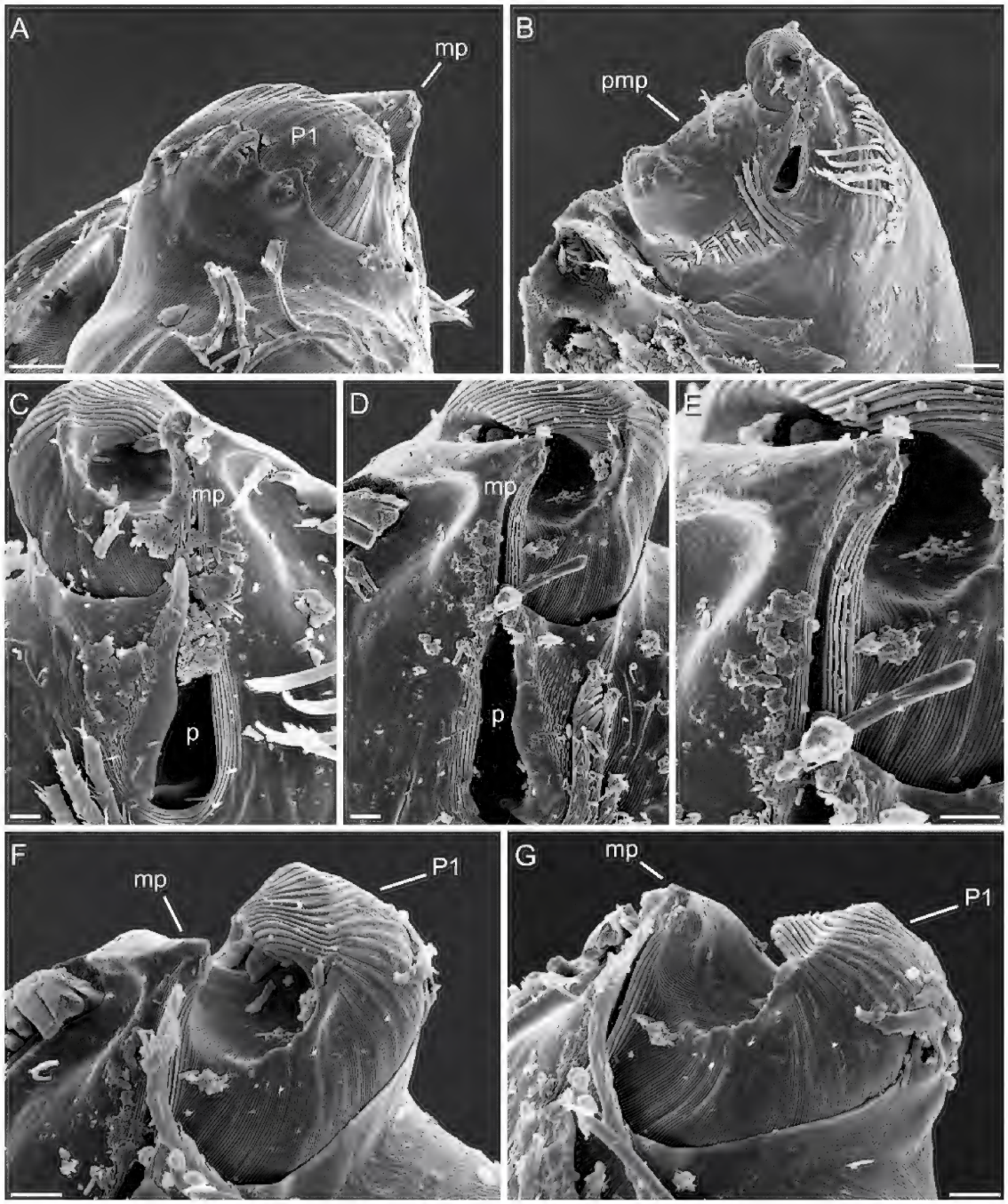


Fig. 20. *Zyngoonops redii*, new species, male. **A.** Right endite, mp and P1, posterior view. **B.** Right endite, median view. **C.** Detail of B, showing pocket and mp. **D.** Same region, left endite. **E.** Detail of D, showing mp. **F.** Left endite, mp and P1, median view. **G.** Same, posteromedian view. Abbreviations: **mp,** median projection; **P,** projection; **p,** pocket; **pmp,** posteromedian part of endite. Scale bars: 5 μm (A, C–G), 20 μm (B).

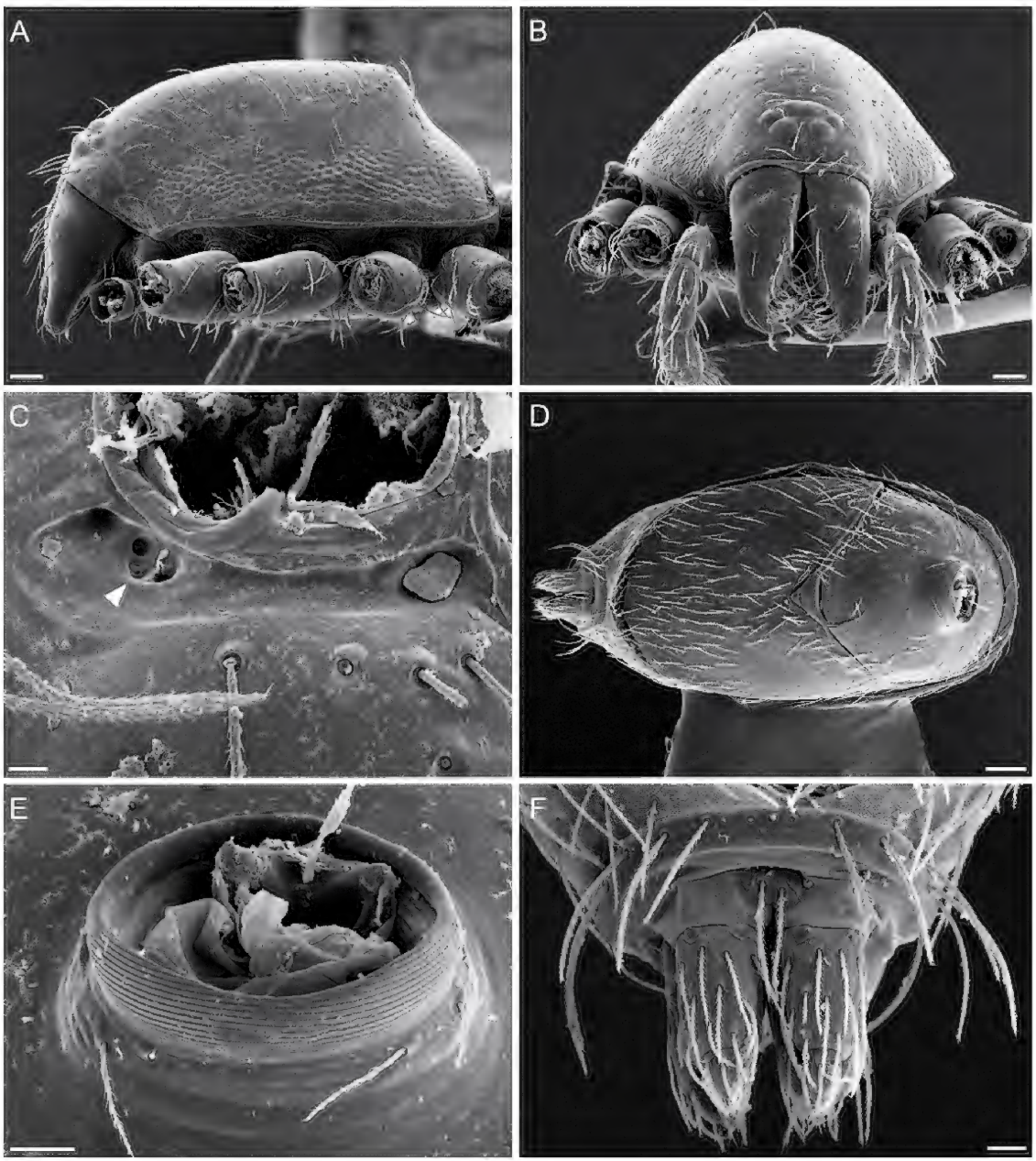


Fig. 21. *Zyngoonops redii*, new species, female. **A.** Carapace, lateral view. **B.** Same, anterior view. **C.** Infracoxal groove, leg II, ventral view. Arrowhead: pores. **D.** Abdomen, ventral view. **E.** Pedicel tube, ventral view. **F.** Spinnerets, ventral view. Scale bars: 5 μm (C), 20 μm (E, F), 40 μm (A, B, D).

Ruwenzori, Ihongero, entre Kalonge et Mahungu, 00°21′N, 029°34′E, Feb. 1, 1953, elev. 2480 m, same collectors (PBI_OON 28583, MRAC 224.219), 1 male. Ruwenzori, riv. Nyamwamba affl. Butahu, près Kalonge, 00°20′N, 029°48′E, Aug. 26, 1952, étage bamboo, elev. 2480 m, same collectors (PBI_OON 28617, MRAC 224.224), 2 males. Ruwenzori, Kalonge, 00°20′N, 029°48′E, no date given, humus sous bambous, elev. 2210 m, same collectors (PBI_OON 28594, MRAC 224.215), 1 female. Ruwenzori, Mahangu, 00°21′N, 029°50′E, Aug. 30, 1955, Berlèse, elev. 3350 m, Vanschuytbroeck P. (PBI_OON 28643, MRAC 224.223), 1 male. Ruwenzori, Vuhonga, Aug. 22, 1955, Berlèse,

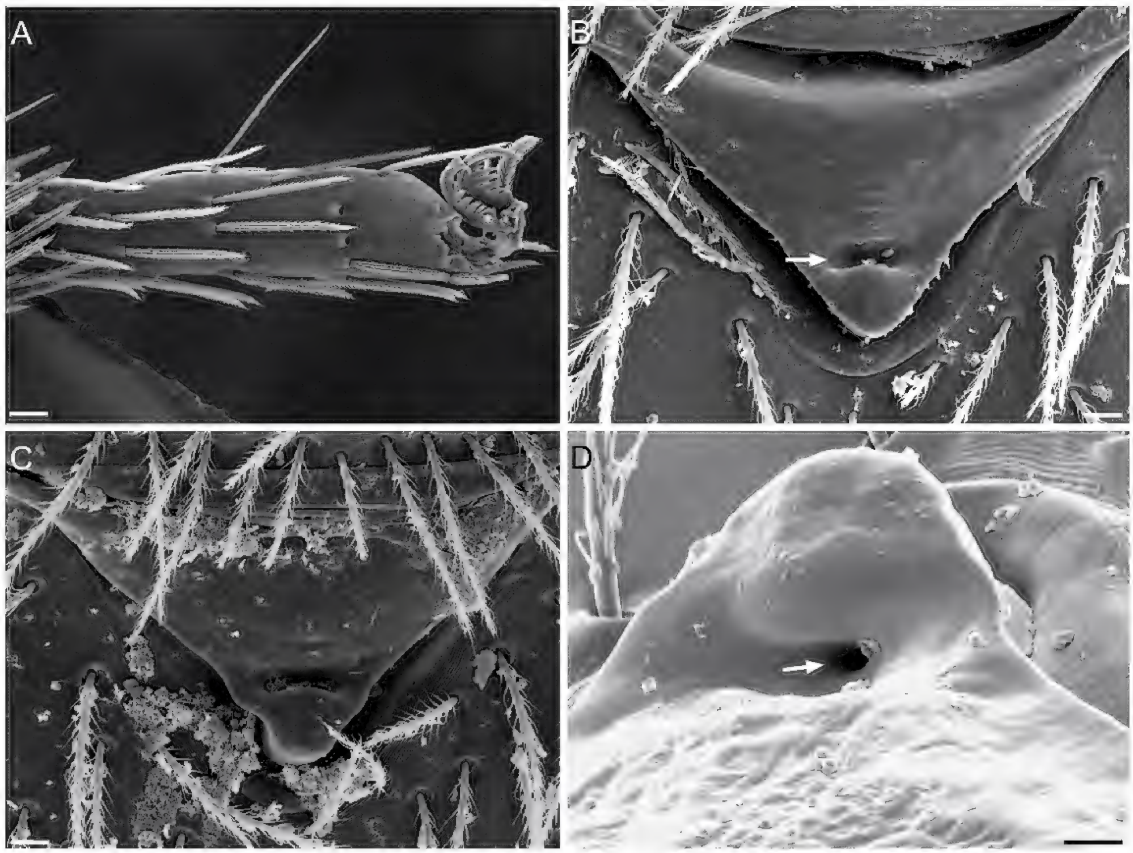


Fig. 22. *Zyngoonops redii*, new species, female. **A.** Tarsus, leg IV, lateral view. **B.** Epigastric scape, ventral view. Arrow: shallow groove. **C.** Same, other specimen. **D.** Epigastric scape, shallow groove, anterior view. Arrow: small round opening. Scale bars: 2.5 μm (D), 5 μm (B, C), 10 μm (A).

elev. 2200 m, Vanschuytbroeck P. (PBI_OON 28597, MRAC 224.226), 1 male. Same data (PBI_OON 28605, MRAC 224.221), 2 females.

DISTRIBUTION: Known only from the Kivu region, D.R.C. (map 3), where the species is sometimes sympatric with *Z. swammerdami* and *Z. marki*.

***Zyngoonops chambersi*, new species**
Figures 45–56, 104, 105D; map 2

TYPES: Female holotype: D.R.C., face nord du Ruwenzori, camp de Kikura, vallée de la Kafuko, 00°35′N, 029°57′E, July–August, 1974, dans terreau, elev. 2000 m, Lejeune M. (PBI_OON 28637, MRAC 224.194). Paratype: same data (PBI_OON 28550, MRAC 224.192), 1 female. Paratype: same data (PBI_OON 33274, MRAC 230.591), 1 male.

ETYMOLOGY: Named after the Scottish writer and publisher Robert Chambers (1802–1871). In his book *Vestiges of the Natural History of Creation* (1844) Chambers argued for an evolutionary view of life.

DIAGNOSIS: Males resemble those of *Z. beatriceae* but differ in having a P2 projection with a prominent anterolateral extension (figs. 46E, F, 47C, 48A, B). Females can be recognized by the large scape that gradually widens posteriorly (figs. 49D, 52E, 105D).

MALE (figs. 45–48, 49A, B, 104A–F): TL 1.45. Habitus as in figure 45A. Carapace strongly elevated in lateral view; posterodorsal part reclining (fig. 45B). Carapace stripes as in *Z. beatriceae*. Inner surface of carapace wall showing ridges; the ridges presumably correspond to the red stripes (fig. 45C). Six eyes; ALE about one diameter apart; PME

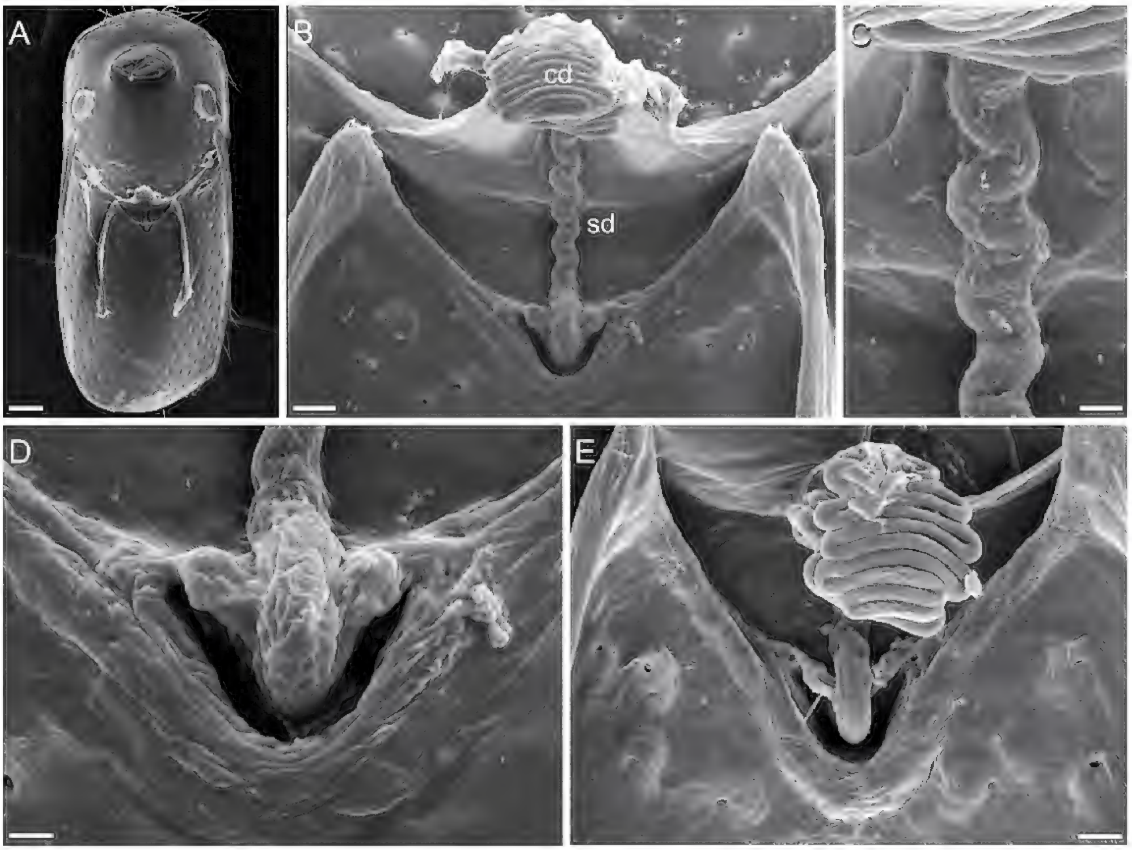


Fig. 23. *Zyngoonops redii*, new species, female. **A.** ES and PES, dorsal view. **B.** Internal genitalia, dorsal view, showing straight (sd) and coiled (cd) part of duct. **C.** Detail of B, showing straight part of duct. **D.** Detail of B, showing proximal part of duct. **E.** Other specimen, internal genitalia, dorsal view. Scale bars: 2 μm (C, D), 5 μm (B, E), 30 μm (A).

oval, touching or almost touching; PLE oval, well separated from PME. Endites as in *Z. beatriceae,* but P2 with a prominent anterolateral extension (figs. 46E, F, 47C, 48A, B). Booklung covers medium sized, darker than surrounding scutum. Ventral lip not constricted. DS long, covering almost entire dorsum, fused to ES (fig. 48F). PES fused to ES, forming single ventral scutum that covers nearly full length of abdomen. Lateral apodemes long, distally slightly inward curved. PLS with three spigots (fig. 49B).

FEMALE (figs. 49C, D, 50–56, 104G, H, 105D): TL 1.53. Habitus as in figure 50A. Carapace without stripes. Eyes as in male. Booklung covers medium sized, darker than surrounding scutum. Ventral lip not constricted (fig. 51F). DS long, covering almost entire dorsum. PES long, most of ventral abdomen covered (fig. 51E). Epigastric scape as in figures 49D, 52E, 105D, more than half as long as PES. Internal genitalia as in figures 52F, G, 53–56. Genital pouch present (figs. 52G, 53E). Distal part of genital duct highly coiled (fig. 53A, F); a section through the coiled part reveals numerous small, round structures (fig. 54B); these structures have a thick wall and a dark center (presumably they are cross sections through the duct).

OTHER MATERIAL EXAMINED: **D.R.C.:** Face nord du Ruwenzori, camp de Kikura, vallée de la Kafuko, 00°35′N, 029°57′E, July–Aug. 1974, dans terreau, elev. 2000 m, Lejeune M. (PBI_OON 28625, MRAC 154.012), 1 male. Same data (PBI_OON 9830, 9853, 9854, 28598, 28585, MRAC 224.193, 224.195, 224.197, 154.058, 154.853), 2 males, 7 females. Same locality and date, sol suspendu, elev.

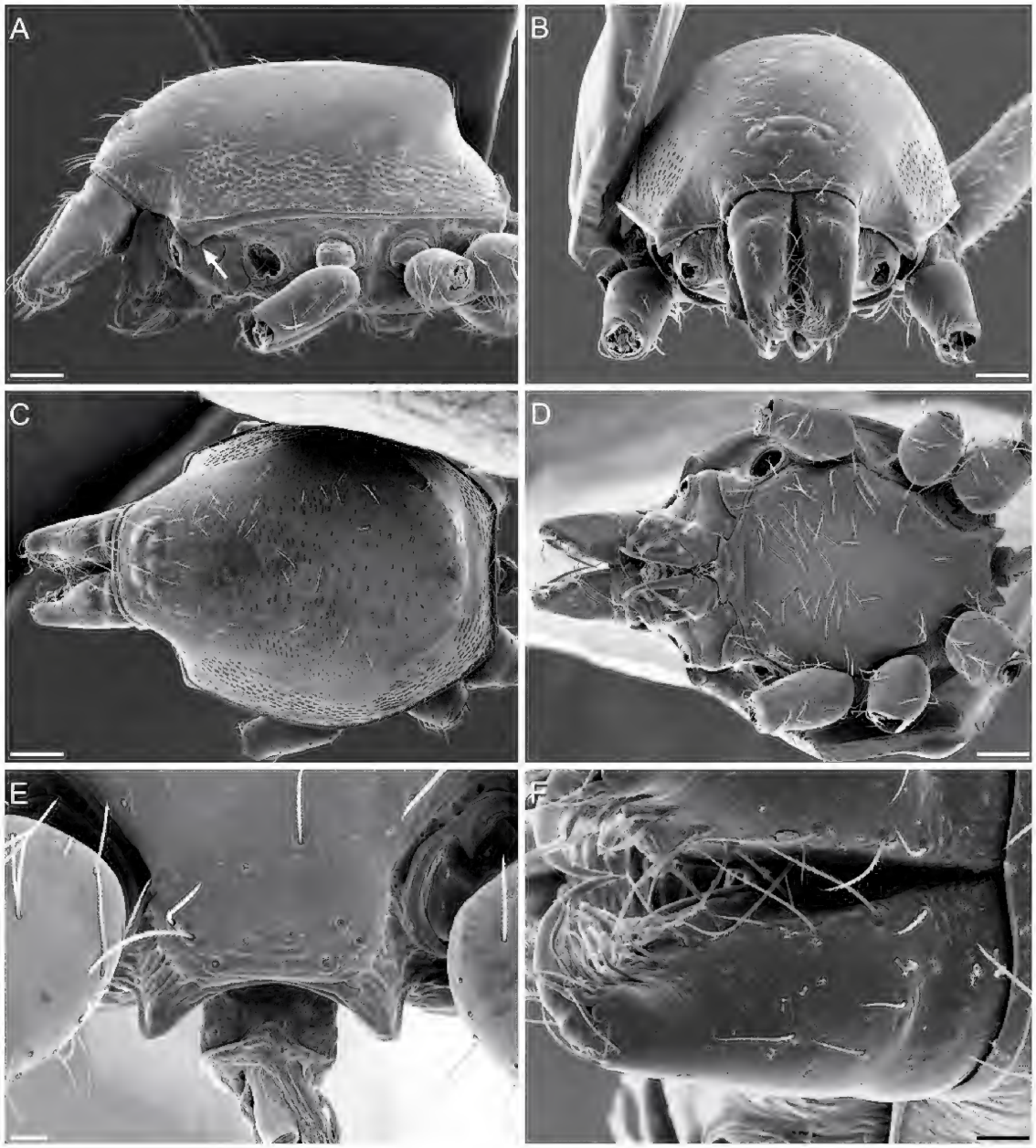


Fig. 24. *Zyngoonops goedaerti*, new species, male. **A.** Carapace, lateral view. Arrow: extended anterolateral corner. **B.** Same, anterior view. **C.** Same, dorsal view. **D.** Same, ventral view. **E.** Sternal prongs, ventral view. **F.** Chelicerae, anterior view. Scale bars: 20 μm (E, F), 100 μm (A–D).

2000 m, Lejeune M. (PBI_OON 28599, MRAC 154.013), 1 female. Same locality and date, dans souche de fougères mortes, elev. 2000 m, Lejeune M. (PBI_OON 28584, MRAC 154.017), 1 female. Face nord du Ruwenzori, camp de Kikura, vallée de la Ruanoli, 00°35′N, 029°57′E, July–Aug. 1974, litière de fougères, elev. 2000 m, Lejeune M. (PBI_OON 28516, MRAC 154.671), 1 female. Same locality and date, terreau sous litière, elev. 2000 m, Lejeune M. (PBI_OON 28602, MRAC 155.446), 1 female. Kivu, Butembo, vallée Musosa, 00°09′N, 029°17′E, Apr. 1968, elev. 1745 m, Lejeune M. (PBI_OON 28525,

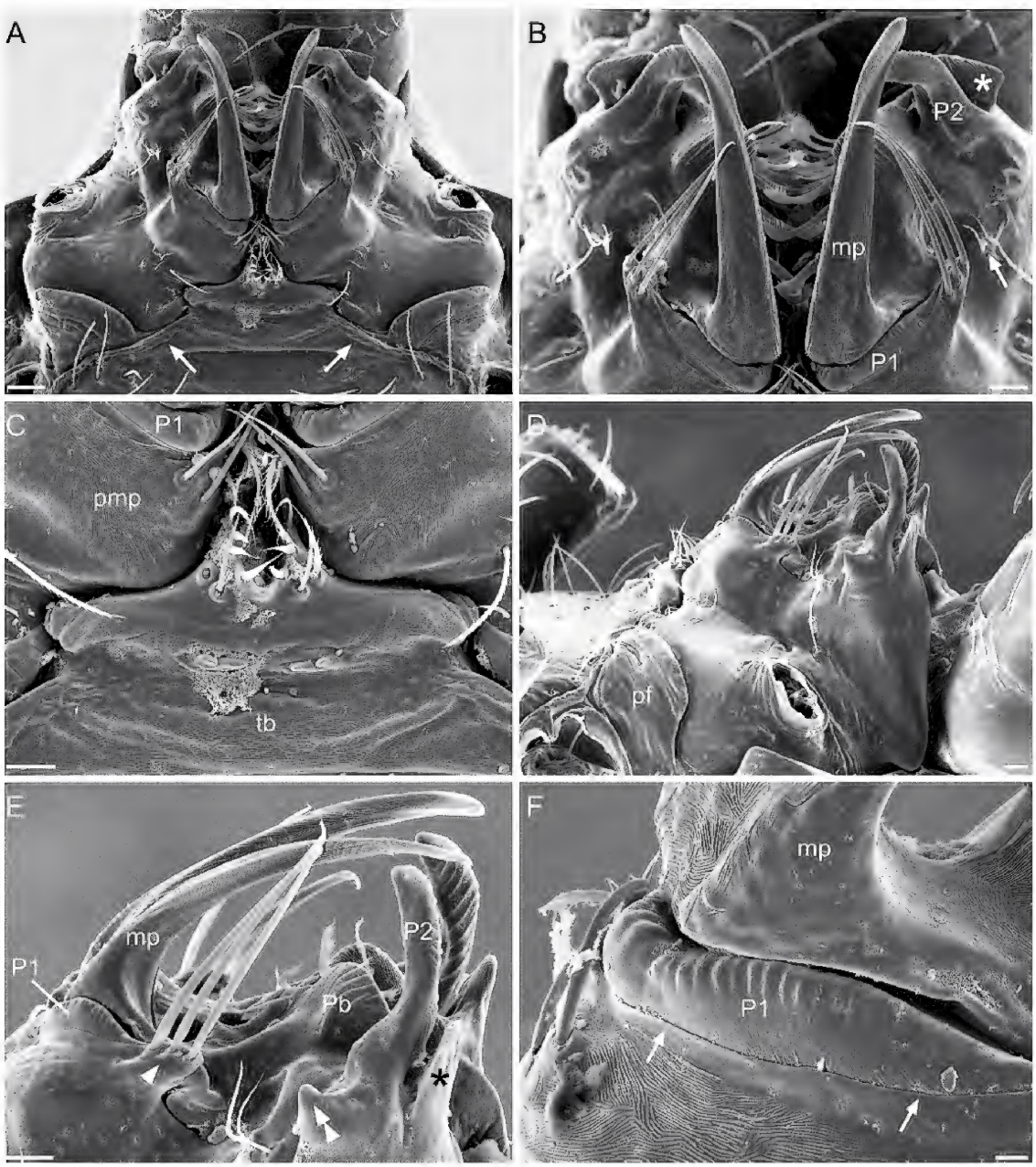


Fig. 25. *Zyngoonops goedaerti*, new species, male. **A.** Mouthparts, ventral view. Arrows: oblique ridges. **B.** Detail of A, showing median part of endites. Asterisk: projection Pa. Arrow: seta 4. **C.** Labium, ventral view. **D.** Endites, lateral view. **E.** Detail of D. Asterisk: projection Pa. Arrowhead: setae 1–3. Double arrowhead: projection Pc. **F.** Left endite, P1, lateral view. Arrows: groove. Abbreviations: **mp,** median projection; **P,** projection; **Pb,** projection b; **pf,** pleural flap; **pmp,** posteromedian part of endite; **tb,** transverse band. Scale bars: 2 μm (F), 10 μm (B–E), 20 μm (A).

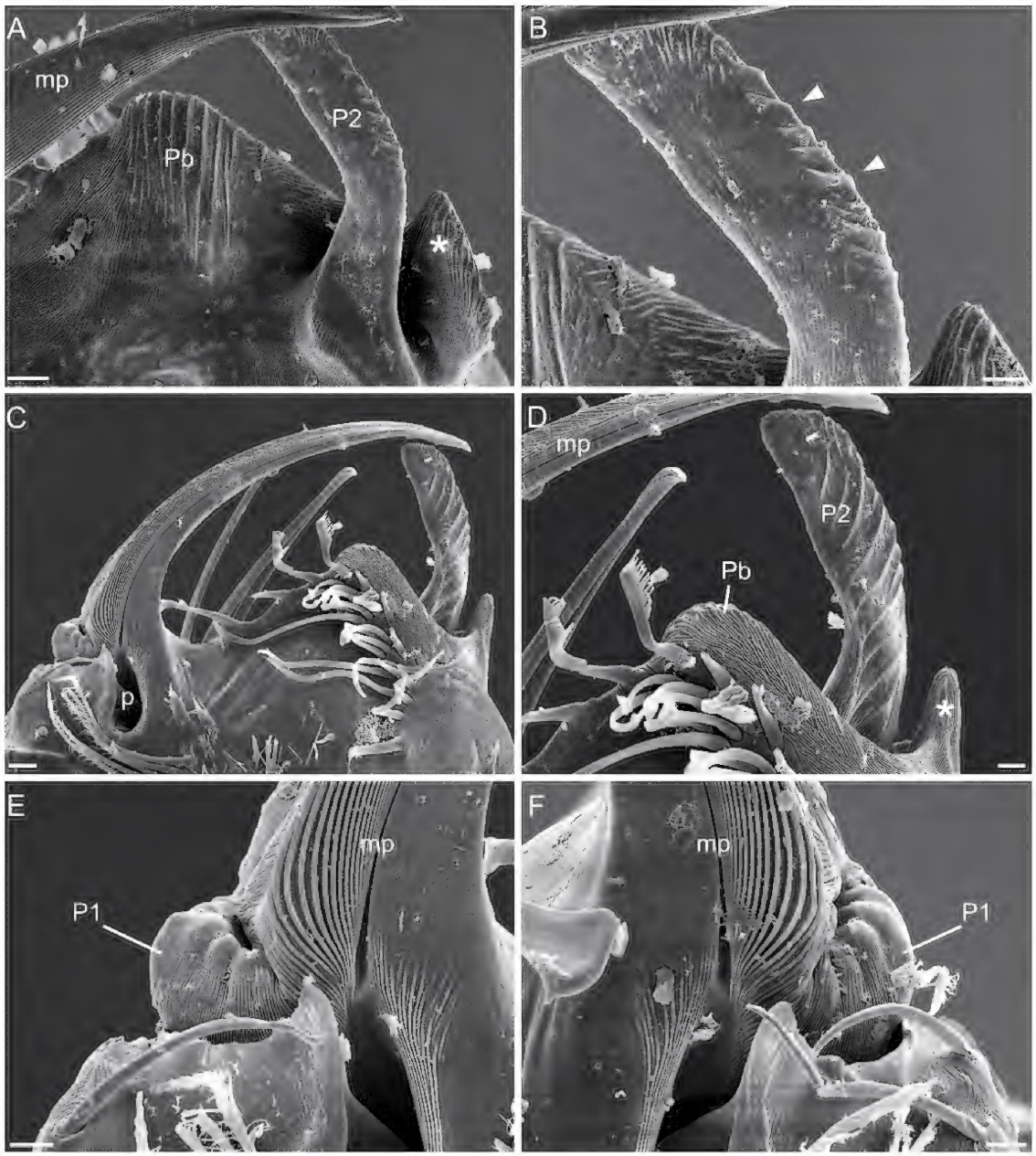


Fig. 26. *Zyngoonops goedaerti*, new species, male. **A.** Left endite, projections Pa (asterisk), Pb and P2, lateral view. **B.** Detail of A, showing P2. Arrowheads: serrated edge. **C.** Right endite, median view. **D.** Detail of C, showing Pa (asterisk), Pb and P2. **E.** Detail of C, showing P1. **F.** Same region, left endite. Abbreviations: **mp,** median projection; **P,** projection; **p,** pocket; **Pb,** projection b. Scale bars: 3 μm (B, D–F), 5 μm (A, C).

MRAC 134.027), 4 females. Same data (PBI_OON 28568, 9829, 9833, MRAC 134.069, 224.191, 224.196), 3 males. Butembo, 00°09′N, 029°17′E, Feb.–Mar. 1975, litières de fougères décomposées, elev. 1750 m, Lejeune M. (PBI_OON 28577, MRAC 161.340), 2 females. Same data (PBI_OON 28536, MRAC 161.362), 1 female. Ruwenzori, Kyandolire, Mulaku affl. g. Kakalari, 00°20′N, 029°45′E, Oct. 15,

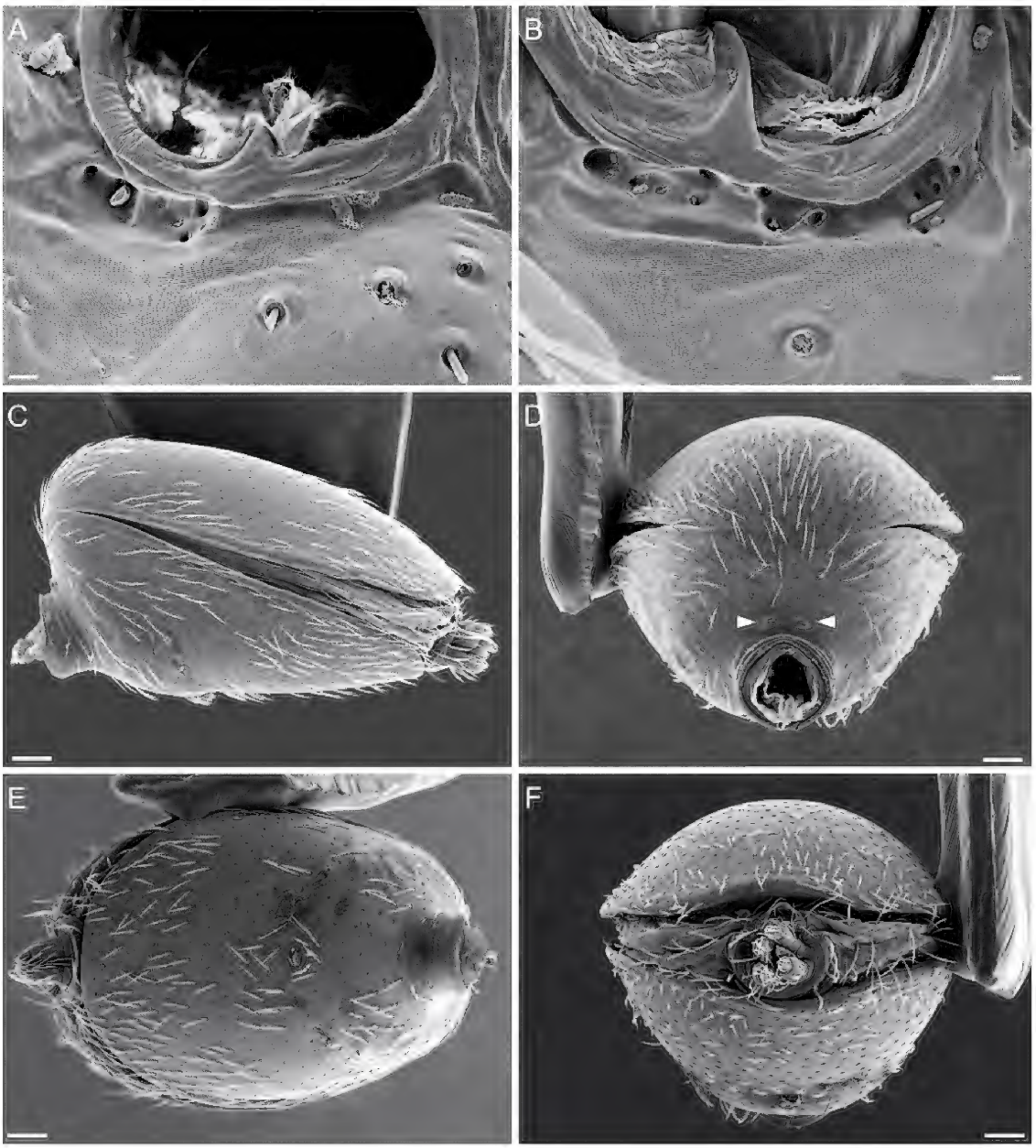


Fig. 27. *Zyngoonops goedaerti*, new species, male. **A.** Infracoxal groove, leg II, ventral view. **B.** Same, leg IV, ventral view. **C.** Abdomen, lateral view. **D.** Same, anterior view. Arrowheads: tubercles. **E.** Same, ventral view. **F.** Same, posterior view. Scale bars: 5 μm (A, B), 50 μm (C–F).

1952, terreau berge de la rivière, elev. 1750 m, Vanschuytbroeck P. and Kekenbosch J. (PBI_OON 9601, MRAC 224.142), 2 males, 2 females. Same data (PBI_OON 28505, MRAC 224.199), 1 female. Same data except date Oct. 10, 1952 (PBI_OON 28615, PPRI), 2 males, 1 female. Same data except date Oct. 14, 1952 (PBI_OON 9608, MRAC 224.168), 2 males. Ruwenzori, Kyandolire, lieu dit camp des gardes, 00°20′N, 029°45′E, Oct. 23–25, 1952, terreau, elev. 1700 m, same collectors (PBI_OON 9186, MRAC 224.143), 5 females. Same data (PBI_OON 9176, 9196, 28555, MRAC 224.166, 224.171, 224.187), 2 males, 6 females. Same data except date Aug. 22, 1952 (PBI_OON 28566, MRAC 224.188), 1 female.

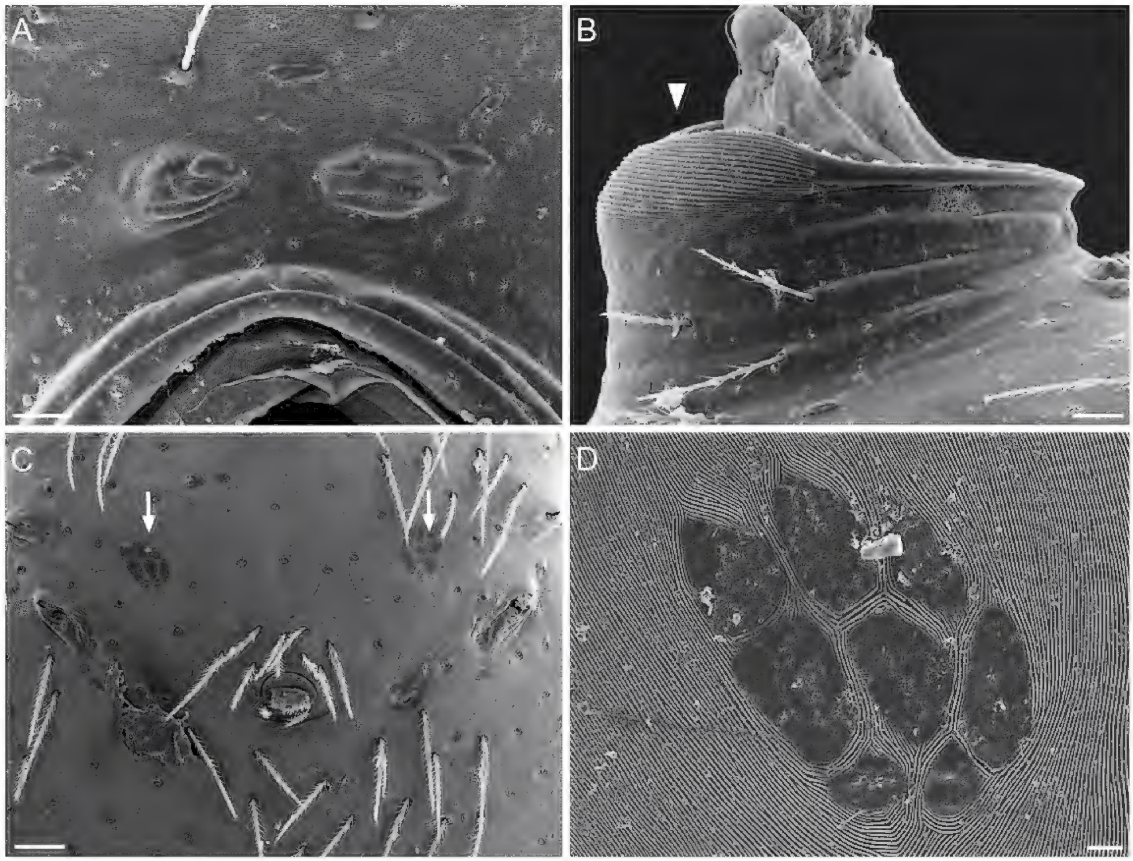


Fig. 28. *Zyngoonops goedaerti*, new species, male. **A.** Tubercles above pedicel tube, anterior view. **B.** Pedicel tube, lateral view. Arrowhead: ventral lip. **C.** Epigastric region, ventral view. Arrows: smooth regions (presumably muscle attachment marks). **D.** Detail of smooth region. Scale bars: 2 μm (D), 10 μm (A, B), 20 μm (C).

Same data except date Oct. 8, 1952 (PBI_OON 28511, MRAC 224.189), 1 male, 1 female. Same data (PBI_OON 9831, 9832, MRAC 224.190, 224.200), 2 males. Ruwenzori, Kyandolire, Bwisonge affl. dr. Butahu, 00°20′N, 029°45′E, Oct. 13, 1952, elev. 1780 m, same collectors (PBI_OON 9673, MRAC 224.146), 1 male, 3 females. Same data (PBI_OON 9178, MRAC 224.147), 1 male.

DISTRIBUTION: Known only from the Kivu region, D.R.C. (map 2), where the species is sometimes sympatric with *Z. swammerdami* and *Z. marki*.

***Zyngoonops swammerdami*, new species**
Figures 57–64; map 4

TYPES: Female holotype: D.R.C., Ruwenzori, Kyandolire, lieu dit camp des gardes, 00°20′N, 029°45′E, Oct. 23, 1952, elev. 1700 m, Vanschuytbroeck P. and Kekenbosch J. (PBI_OON 28547, MRAC 224.240). Paratypes: same locality, Oct. 18, 1952, elev. 1700 m, same collectors (PBI_OON 33811, 33812, MRAC 230.506, 230.507), 1 male, 1 female. Paratype: same locality, Oct. 8, 1952, terreau, berlese, elev. 1700 m, same collectors (PBI_OON 28642, MRAC 224.234), 1 male.

ETYMOLOGY: Named after the Dutch naturalist Jan Swammerdam (1637–1680). Swammerdam made key discoveries in human physiology and pioneered the scientific study of insects.

DIAGNOSIS: Males resemble those of *Z. marki* but have slightly shorter median projections (fig. 57D, E) and smaller P2 and P3 projections (figs. 57D–F, 58B). Females

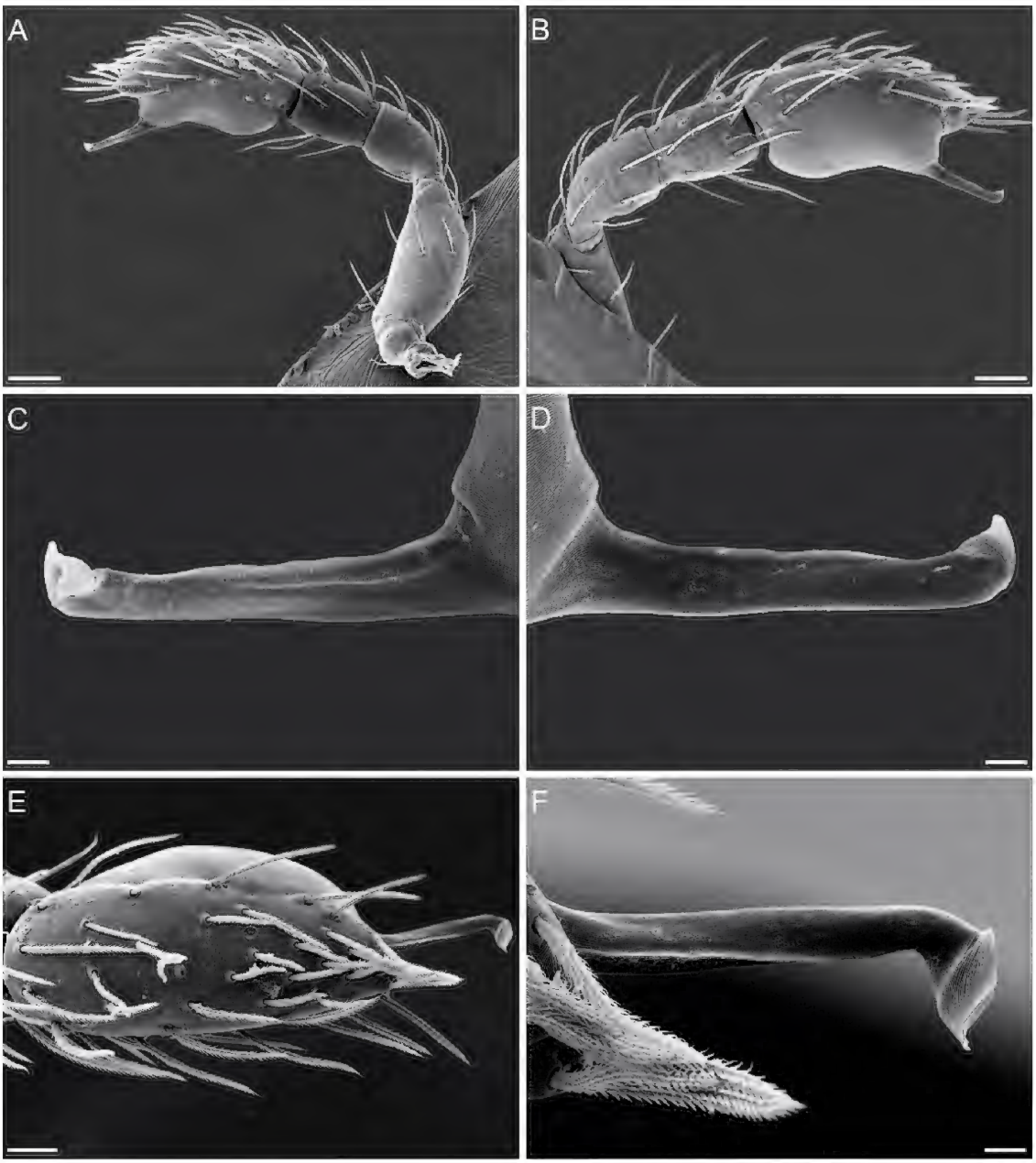


Fig. 29. *Zyngoonops goedaerti*, new species, male. **A.** Pedipalp, prolateral view. **B.** Same, retrolateral view. **C.** Embolus, prolateral view. **D.** Same, retrolateral view. **E.** Cymbium, dorsal view. **F.** Embolus, dorsal view. Scale bars: 5 μm (C, D, F), 20 μm (E), 40 μm (A, B).

resemble those of *Z. redii* but lack a groove in the epigastric scape (figs. 60B, 61D–F).

MALE (figs. 57–59): TL 1.12. Habitus as in figure 57A. Carapace without stripes. Six eyes; ALE less than one diameter apart; PME oval, touching or almost touching; PLE round to oval, well separated from PME. Endites with four projections (mp, P2, P3, P4); mp rather short, somewhat thornlike, directed anteriorly (figs. 57D, E, 58D); P2

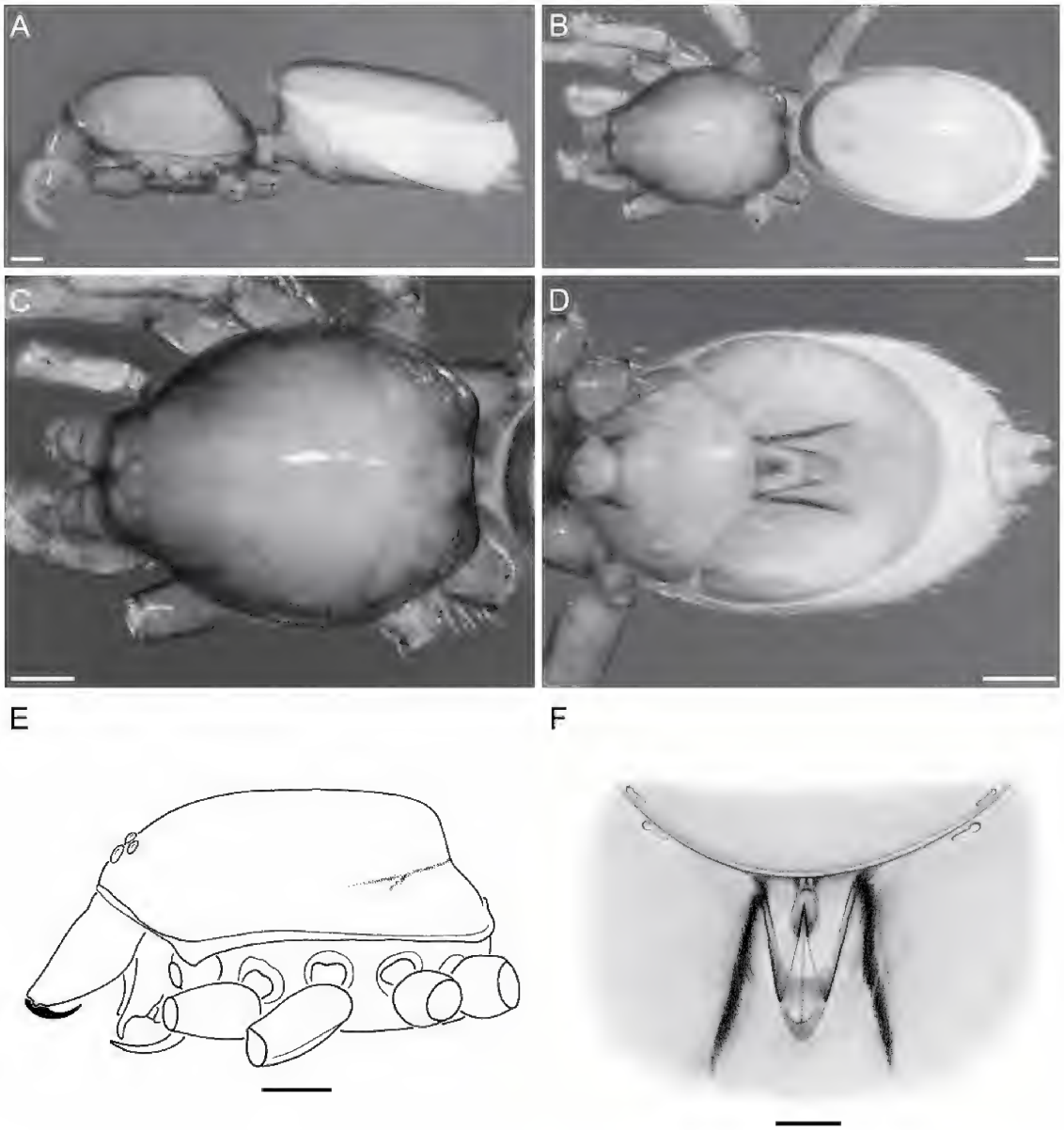


Fig. 30. *Zyngoonops goedaerti*, new species, female (A–D, F) and male (E). **A.** Habitus, lateral view. **B.** Same, dorsal view. **C.** Carapace, dorsal view. **D.** Abdomen, ventral view. **E.** Carapace, lateral view. **F.** Epigastric region, ventral view. Scale bars: 50 μm (F), 100 μm (A–E).

relatively small, broad, somewhat platelike, median surface strongly ribbed, shaft of seta s4 resting on surface of projection (figs. 57D–F, 58B, E, F); P3 cone shaped, relatively small (figs. 57E, 58B, F); P4 somewhat cone shaped (figs. 58E, F, 59B). Setae s1–3 as in figures 57D, E, 58B. Booklung covers relatively small. Ventral lip not constricted. DS long, covering almost entire dorsum, fused to ES (fig. 57A). PES fused to ES, forming single ventral scutum that covers nearly full length of abdomen. PLS with two spigots.

FEMALE (figs. 60–64): TL 1.15. Habitus as in figure 60A. Carapace without stripes. Eyes as in male. Booklung covers relatively small. Ventral lip not constricted. DS long, covering

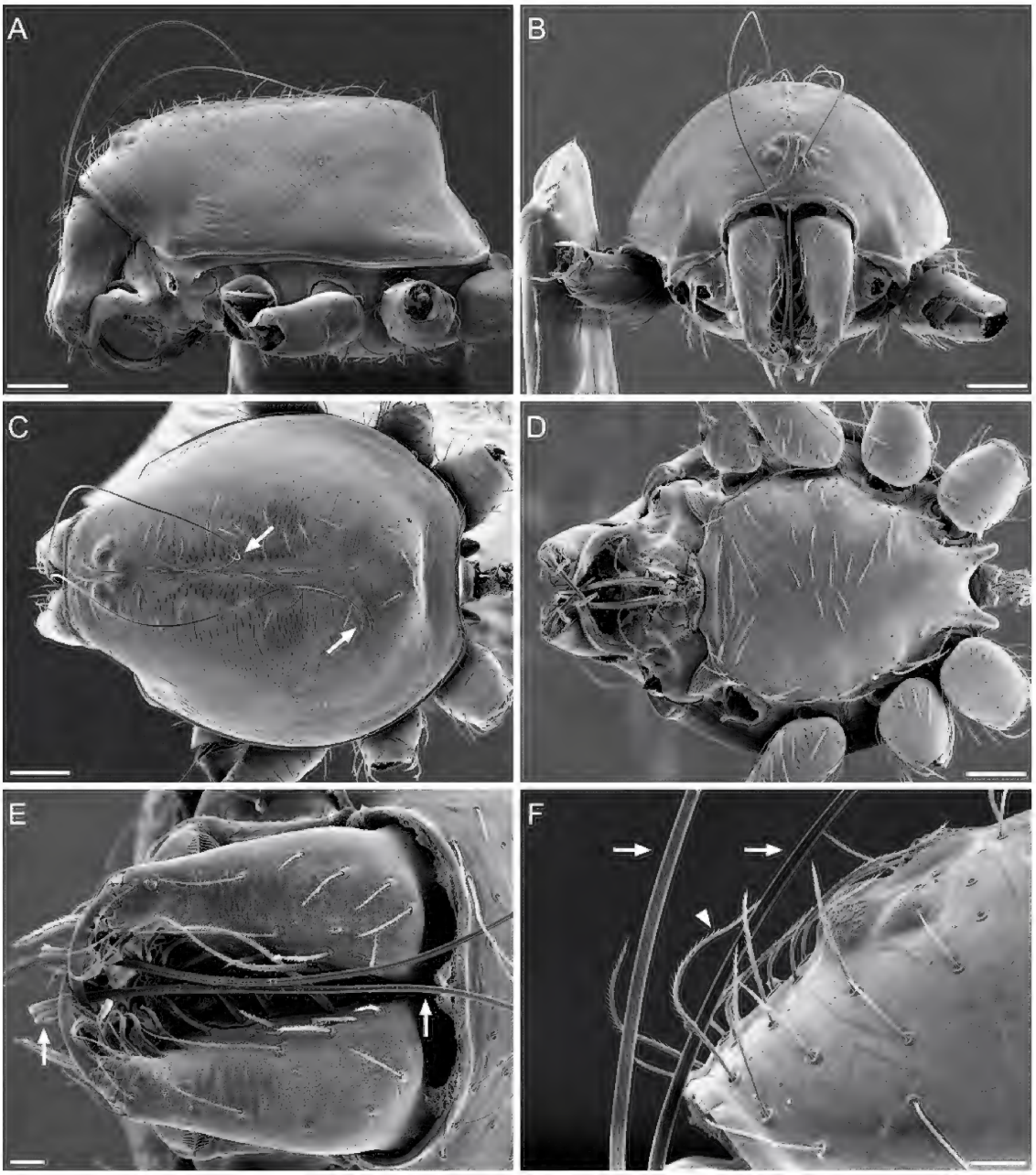


Fig. 31. *Zyngoonops rockoxi*, new species, male. **A.** Carapace, lateral view. **B.** Same, anterior view. **C.** Same, dorsal view. Arrows: median projections. **D.** Same, ventral view. **E.** Chelicerae, anterior view. Arrows: median projections. **F.** Clypeus, lateral view. Arrows: median projections. Arrowhead: posteriorly directed seta. Scale bars: 20 μm (E, F), 100 μm (A–D).

almost entire dorsum. PES long, most of ventral abdomen covered (fig. 61C). Epigastric scape triangular, elevated above PES (figs. 60B, 61D–F). Internal genitalia as in figures 62–64. Genital pouch present (fig. 62B). Distal part of genital duct highly coiled (figs. 62D, 63D, E, 64A).

OTHER MATERIAL EXAMINED: **D.R.C.:** Ruwenzori, Kyandolire, lieu dit camp des gardes,

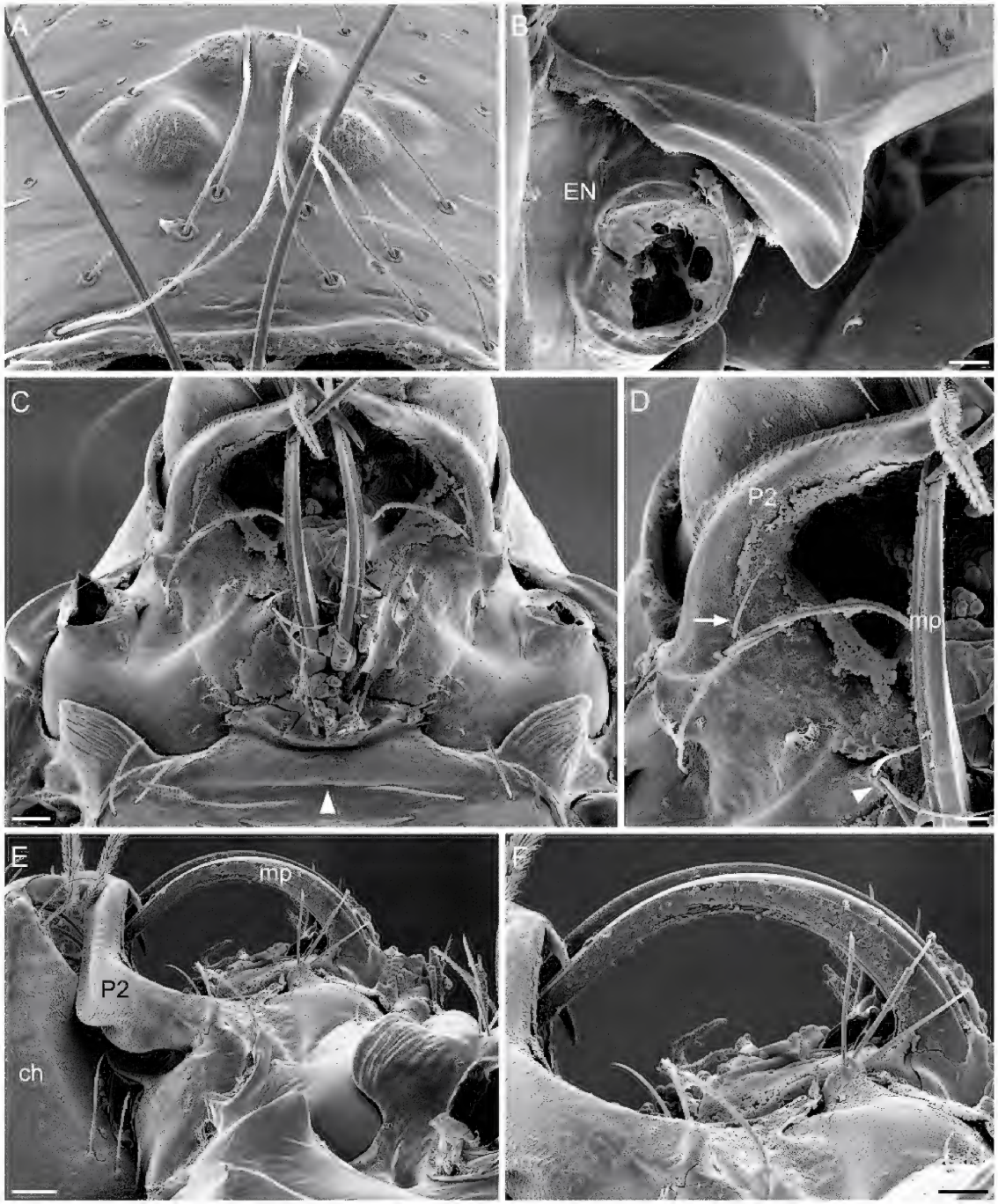


Fig. 32. *Zyngoonops rockoxi*, new species, male. **A.** Eyes, anterior view. **B.** Carapace, extended anterolateral corner, anterior view. **C.** Mouthparts, ventral view. Arrowhead: posterior margin of transverse bar. **D.** Detail of C, showing median part of right endite. Arrowhead: setae 1–3. Arrow: seta 4. **E.** Endites, lateral view. **F.** Detail of E, showing median projection. Abbreviations: **ch,** chelicera; **EN,** endite; **mp,** median projection; **P,** projection. Scale bars: 10 μm (A, B, D, F), 20 μm (C, E).

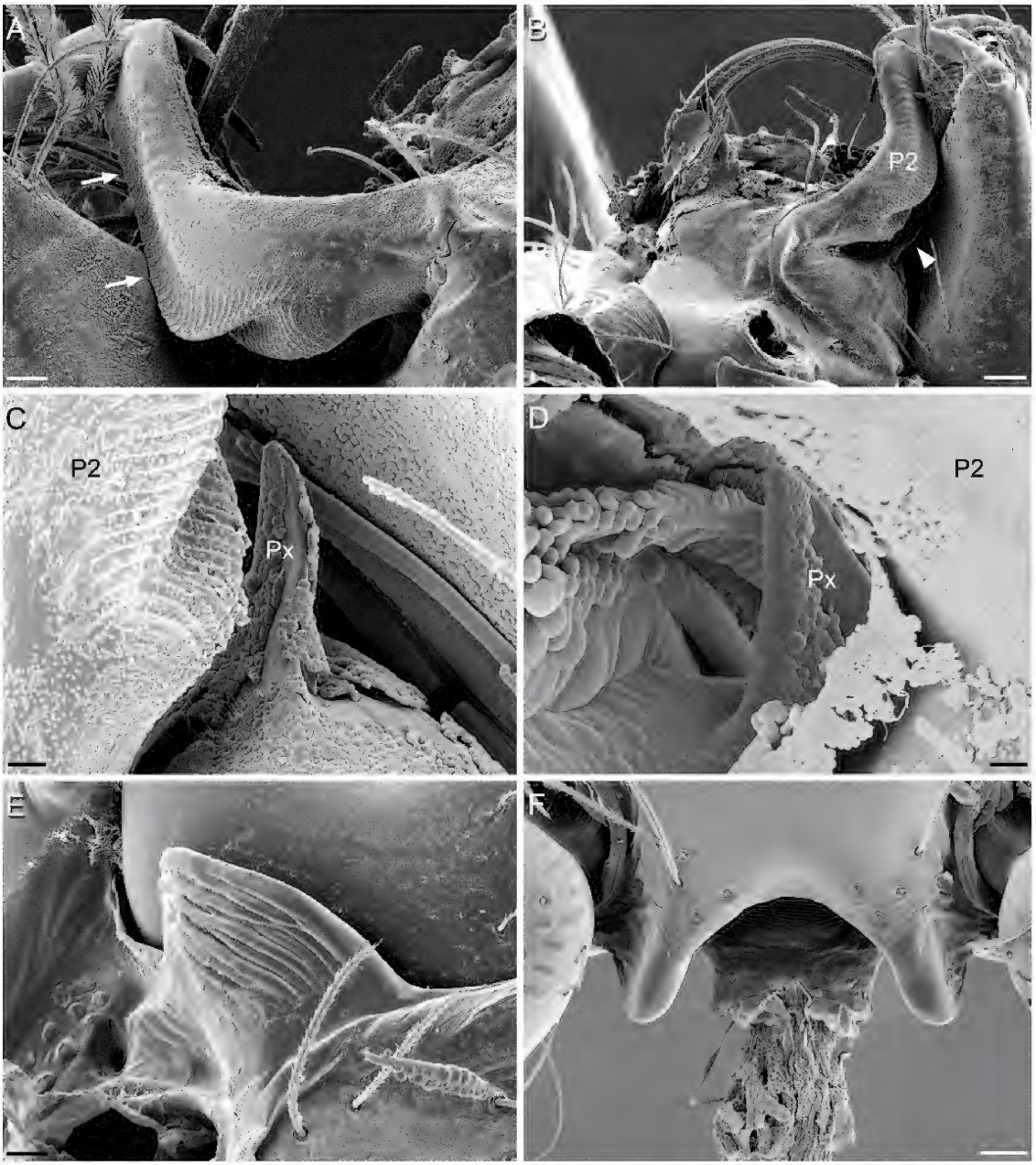


Fig. 33. *Zyngoonops rockoxi*, new species, male. **A.** P2, lateral view. Arrows: flange. **B.** Endites, lateral view. Arrowhead: Px. **C.** Projection Px, lateral view. **D.** Same, ventral view. **E.** Pleural flap, ventral view. **F.** Sternal prongs, ventral view. Abbreviations: **P,** projection; **Px,** projection x. Scale bars: 5 μm (C, D), 10 μm (A, E), 20 μm (B, F).

00°20′N, 029°45′E, Oct. 18, 1952, elev. 1700 m (PBI_OON 28509, PPRI), 2 females. Same locality, no date given, Berlèse, dans terreau, elev. 1700 m (PBI_OON 28532, MRAC 224.239), 1 male. Ruwenzori, ruiss. Katsambu affl. dr. Butahu, 00°20′N, 029°48′E, Feb. 17, 1953, Berlèse, elev. 2000 m (PBI_OON 28612, MRAC 224.228), 1 male. Same data except date Mar. 27, 1953 (PBI_OON 28520, PPRI), 1 male. Same data except date Feb. 12, 1953 (PBI_OON 28588,

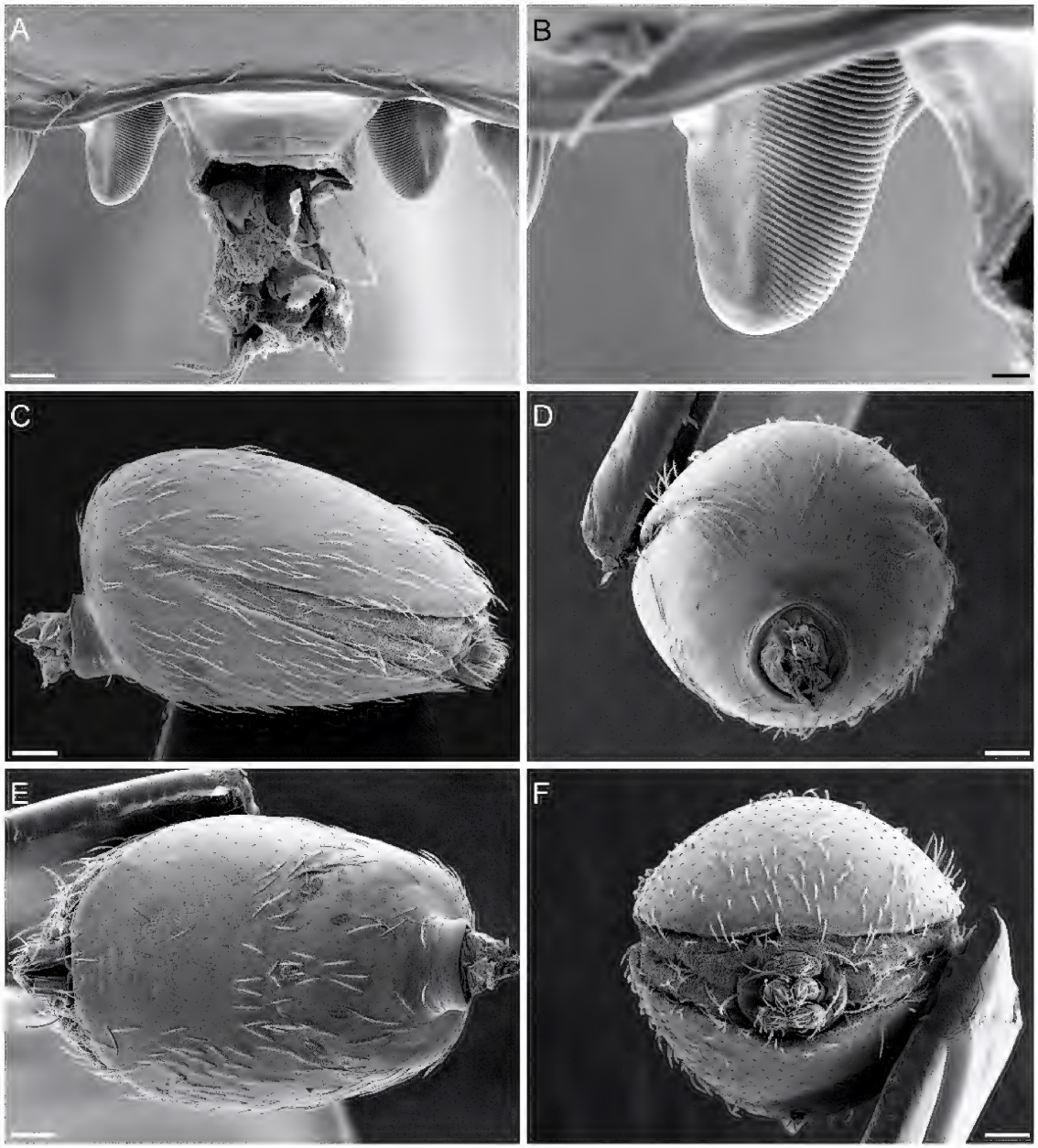


Fig. 34. *Zyngoonops rockoxi*, new species, male. **A.** Sternal prongs, dorsal view. **B.** Same, detail of prong. **C.** Abdomen, lateral view. **D.** Same, anterior view. **E.** Same, ventral view. **F.** Same, posterior view. Scale bars: 5 μm (B), 20 μm (A), 50 μm (C–F).

MRAC 224.238), 1 female. Same data (PBI_OON 28574, MRAC 224.242), 2 females. Ruwenzori, Kalonge, ruiss. Katsambu affl. dr. Butahu, 00°20′N, 029°48′E, Jan. 26, 1953, terreau berge, elev. 2000 m (PBI_OON 28527, MRAC 224.236), 1 female. Ruwenzori, Bwisonge affl. dr. Butahu, près Kyandolire, 00°20′N, 029°45′E, Oct. 14, 1952, terreau berge rivière, elev. 1750 m (PBI_OON 28512, MRAC 224.230), 2 males. Ruwenzori, riv. Basika affl. dr. Lume, près Migeri, 00°16′N, 029°47′E, Apr. 16, 1953, Berlèse, elev. 1700 m (PBI_OON 28531, MRAC 224.232), 2 males. Same data (PBI_OON 28634, MRAC 224.245), 1 female. Same data (PBI_OON 28635, MRAC

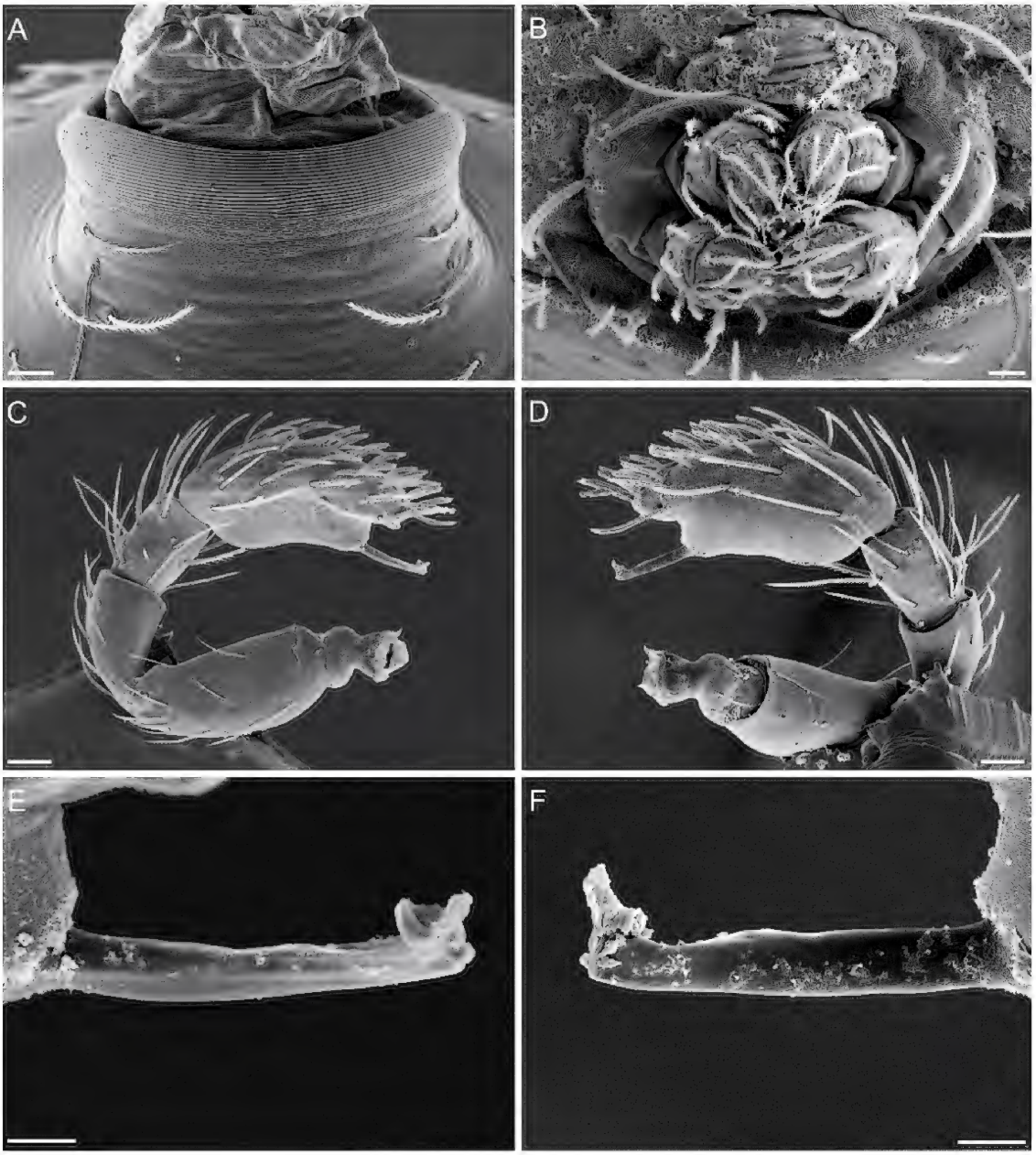


Fig. 35. *Zyngoonops rockoxi*, new species, male. **A.** Pedicel tube, ventral view. **B.** Spinnerets, posterior view. **C.** Pedipalp, prolateral view. **D.** Same, retrolateral view. **E.** Embolus, prolateral view. **F.** Same, retrolateral view. Scale bars: 10 μm (A, B, E, F), 30 μm (C, D).

224.235), 3 males, 1 female. Ruwenzori, Mulaku affl. g. Kakalari, près Kyandolire, 00°20′N, 029°45′E, Oct. 10, 1952, elev. 1750 m (PBI_OON 28558, MRAC 224.233), 2 females. Ruwenzori, Kirivata (= Migeri), 00°16′N, 029°47′E, Apr. 13, 1953, Berlèse, elev. 1760 m (PBI_OON 28549, MRAC 224.237), 1 female. Same data (PBI_OON 28620, MRAC 224.243), 1 female. Ruwenzori, Kirivata (= Migeri), Moyenne Lume, 00°16′N, 029°47′E, Apr. 10–20, 1953, elev. 1760 m (PBI_OON 28564, MRAC 224.244), 1 male. Ruwenzori, Ihongero, piste vers Mahungu,

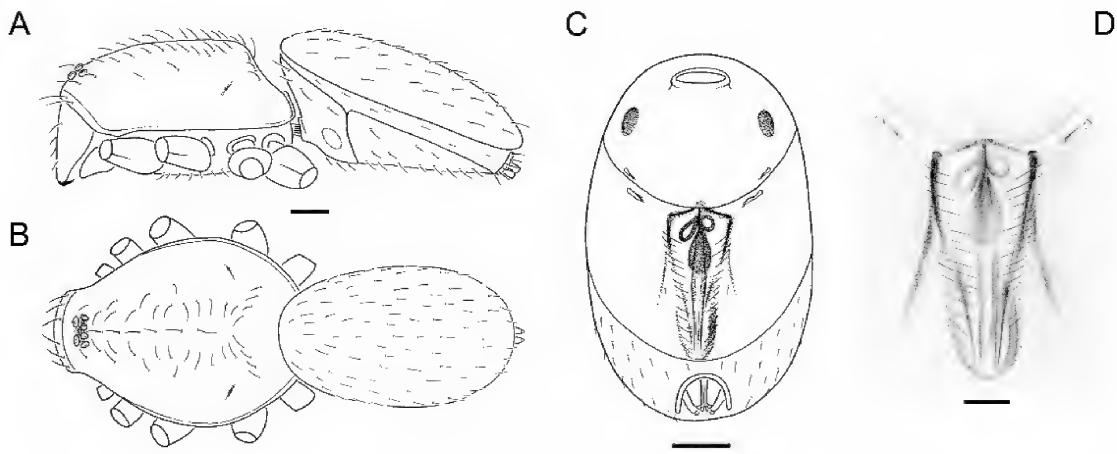


Fig. 36. *Zyngoonops rockoxi*, new species, female. **A.** Habitus, lateral view. **B.** Same, dorsal view. **C.** Abdomen, ventral view. **D.** Epigastric region, ventral view. Scale bars: 50 μm (D), 100 μm (A–C).

00°21′N, 029°34′E, Feb. 1, 1953, Berlèse, elev. 2480 m (PBI_OON 28561, MRAC 224.241), 1 male, 1 female. All material collected by Vanschuytbroeck P. and Kekenbosch J.

DISTRIBUTION: Known only from the Kivu region, D.R.C. (map 4), where the species is sometimes sympatric with *Z. beatriceae*, *Z. marki* or *Z. chambersi*.

***Zyngoonops marki*, new species**
Figures 65–77; map 5

TYPES: Female holotype: D.R.C., Ruwenzori, près de Kalonge, 00°20′N, 029°48′E, Feb. 4, 1953, berlese, elev. 2000 m, Vanschuytbroeck P. and Kekenbosch J. (PBI_OON 28562, MRAC 224.204). Paratype: D.R.C., Ruwenzori, ruiss. Karambura affl. dr. Katauleko, près de Kalonge, 00°20′N, 029°48′E, Jan. 30, 1953, elev. 2060 m, same collectors (PBI_OON 33278, MRAC 230.065), 1 male.

ETYMOLOGY: Named after the author's brother, Mark Fannes.

DIAGNOSIS: Males resemble those of *Z. swammerdami* but have slightly longer median projections (fig. 66C–F) and slightly larger P2 and P3 projections (figs. 66C, E, 67A, C). Females can be recognized by the tongue-shaped epigastric scape (figs. 72B, 75E, F).

MALE (figs. 65–71): TL 1.40. Habitus as in figure 65A. Carapace without stripes. Six eyes; ALE less than one diameter apart; PME oval, touching or almost touching; PLE round to oval, well separated from PME. Endites as in *Z. swammerdami* but median projection slightly longer, needlelike (fig. 66C–F) and P2 and P3 slightly larger (figs. 66C, E, 67A, C). Booklung covers relatively small. Ventral lip not constricted (fig. 68E). DS long, covering almost entire dorsum, fused to ES (fig. 68A). PES fused to ES, forming single ventral scutum that covers nearly full length of abdomen (fig. 68B). PLS with two spigots.

FEMALE (figs. 72–77): TL 1.31. Habitus as in figure 73A. Carapace without stripes. Eyes as in male. Booklung covers relatively small. Ventral lip not constricted (fig. 75C). DS long, covering almost entire dorsum (fig. 75A). PES long, most of ventral abdomen covered (fig. 75B). Epigastric scape tongue shaped (figs. 72B, 75E, F). Internal genitalia as in figures 76, 77. Genital pouch present (figs. 76B, 77A, B). Distal part of genital duct highly coiled (figs. 76D, F, 77E).

OTHER MATERIAL EXAMINED: **D.R.C.:** Ruwenzori, près de Kalonge, 00°20′N, 029°48′E, Feb. 12, 1953, Berlese, elev. 2000 m (PBI_OON 28560, MRAC 224.209), 1 female. Same locality, Jan. 30, 1953, Berlese, elev. 2080 m (PBI_OON 28514, MRAC 224.214), 1 male. Same locality, no date given, humus sous bambous, elev. 2210 m (PBI_OON 28576, MRAC 224.212), 3 females. Ruwenzori, ruiss. Karambura, près de Kalonge, 00°20′N, 029°48′E, Jan. 30, 1955, Berlese, elev. 2060 m (PBI_OON 28578, MRAC 223.397), 1 female. Ruwenzori, ruiss. Karambura affl. dr. Katauleko, près de Kalonge, 00°20′N, 029°48′E, Feb. 14, 1953, Berlese, elev. 2060 m (PBI_OON

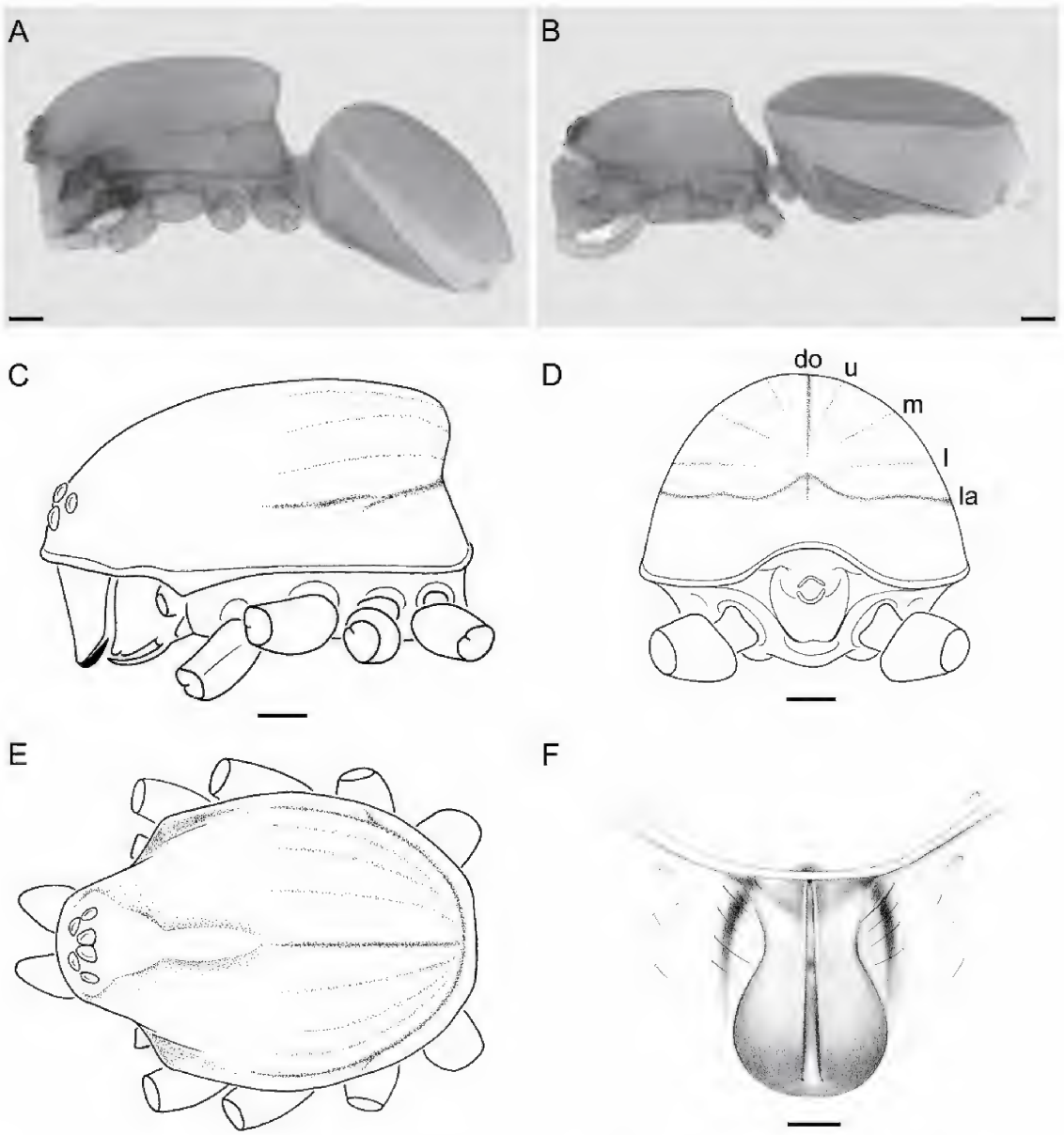


Fig. 37. *Zyngoonops beatriceae*, new species, male (A, C–E) and female (B, F). **A, B.** Habitus, lateral view. **C.** Carapace, lateral view. **D.** Same, posterior view. **E.** Same, dorsal view. **F.** Epigastric region, ventral view. Abbreviations: **do,** dorsal stripe; **l,** lower stripe; **la,** lateral stripe; **m,** middle stripe; **u,** upper stripe. Scale bars: 50 μm (F), 100 μm (A–E).

28518, MRAC 224.203), 1 male. Same data except date Jan. 30, 1953 (PBI_OON 28521, MRAC 224.205), 1 male. Same data except date Jan. 30, 1955 (PBI_OON 28579, MRAC 224.208), 1 male, 1 female. Ruwenzori, Bwisonge affl. dr. Butahu, près de Kyandolire, 00°20′N, 029°45′E, Oct. 14, 1952, terreau berge rivière, elev. 1750 m (PBI_OON 28613, MRAC 224.210), 1 male. Ruwenzori, Mulaku affl. g. Kakalari, près de Kyandolire, 00°20′N, 029°45′E, Feb. 14, 1952, Berlese, elev. 1750 m (PBI_OON 28639, MRAC 224.206), 1 male. Same locality, Oct. 15, 1952, terreau berge rivière, elev. 1750 m (PBI_OON 28608, MRAC 224.211), 1 male, 1 female. Ruwenzori, ruiss. Katsambu affl. dr. Butahu, près de Kalonge, 00°20′N, 029°48′E, Feb. 12, 1953, Berlese, elev. 2000 m (PBI_OON 28616, MRAC

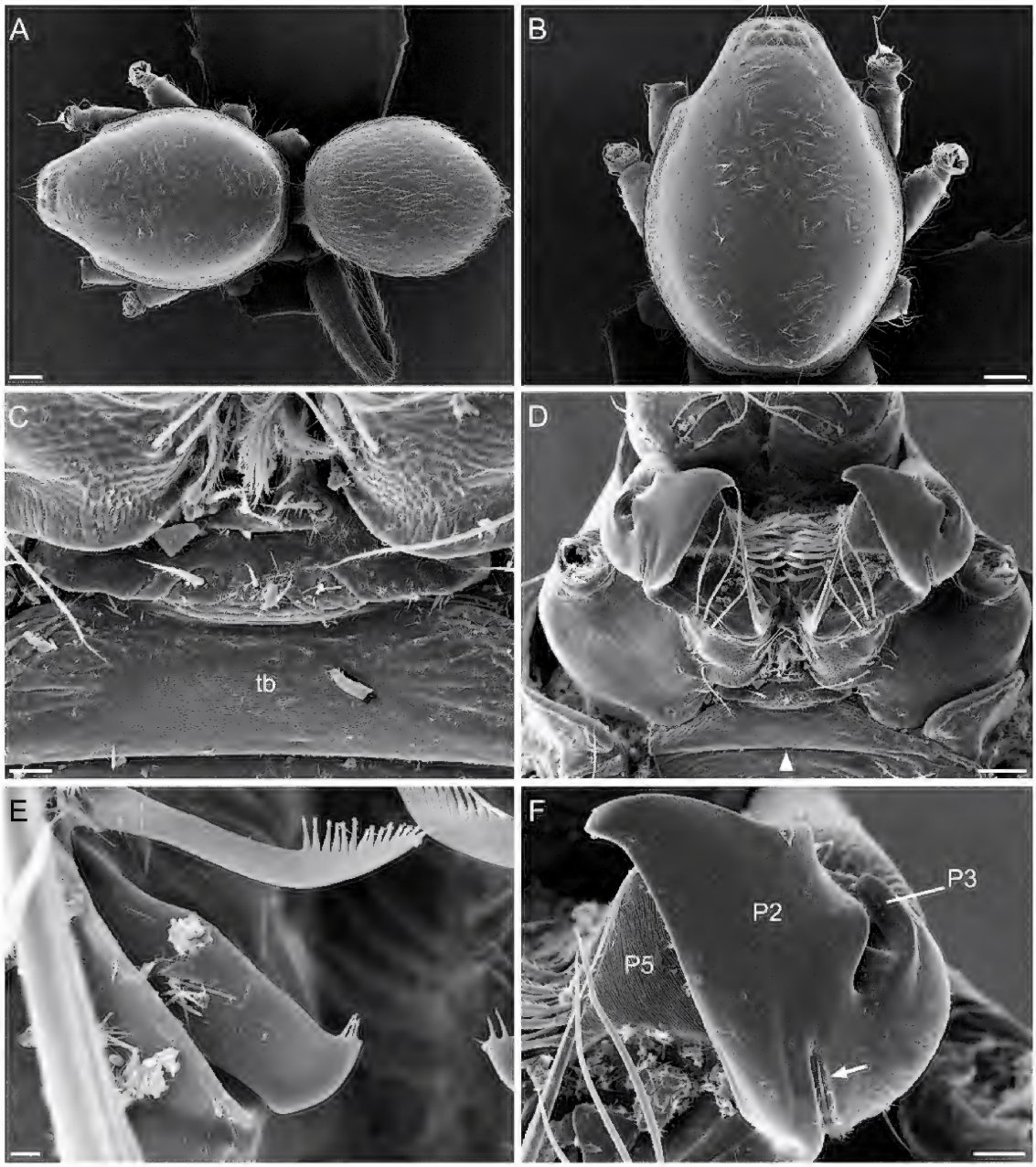


Fig. 38. *Zyngoonops beatriceae*, new species, male. **A.** Habitus, dorsal view. **B.** Carapace, dorsal view. **C.** Labium, ventral view. **D.** Mouthparts, ventral view. Arrowhead: posterior margin of transverse bar. **E.** Detail of D, showing setae of anterior group. **F.** Left endite, projections P2, P3 and P5, ventral view. Arrow: seta 4. Abbreviations: **P,** projection; **tb,** transverse band. Scale bars: 2 μm (E), 10 μm (C, F), 30 μm (D), 100 μm (A, B).

224.207), 1 female. Same data except date Jan. 26, 1953 (PBI_OON 28538, PPRI), 1 male, 1 female. Ruwenzori, Ihongero, piste vers Mahungu, entre Kalonge et Mahungu, 00°21′N, 029°34′E, Feb. 1, 1953, Berlese, elev. 2480 m (PBI_OON 9644, MRAC 224.158), 2 males, 1 female. Same data (PBI_OON 28507, MRAC 224.202), 1 male, 1 female. All material collected by Vanschuytbroeck P. and Kekenbosch J.

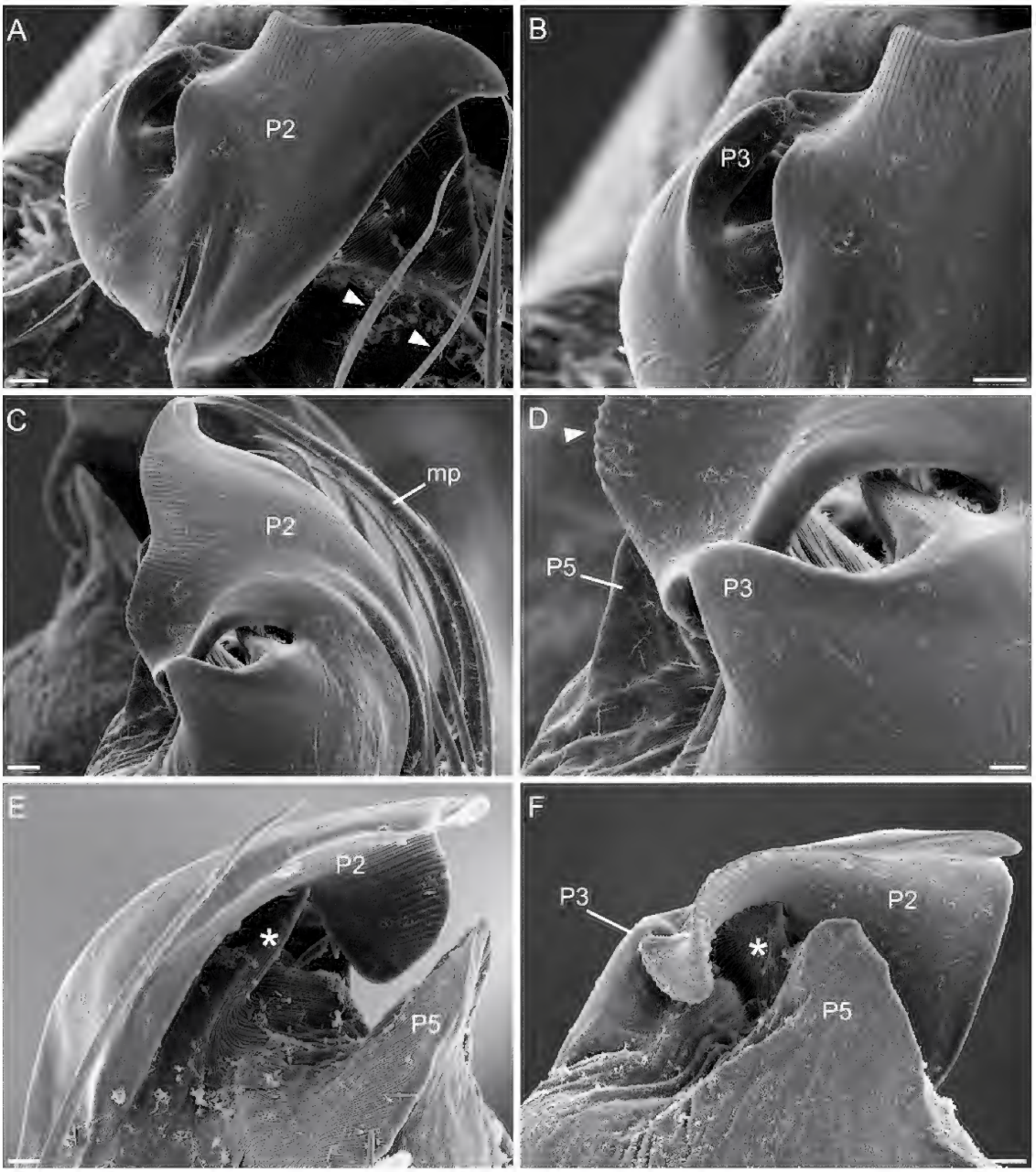


Fig. 39. *Zyngoonops beatriceae*, new species, male. **A.** Right endite, P2, ventral view. Arrowheads: setae 1–3. **B.** Right endite, P3, ventral view. **C.** Right endite, mp and P2, lateral view. **D.** Detail of C, showing P3 and P5. Arrowhead: serrated edge of P2. **E.** Right endite, projections P2, P4 (asterisk) and P5, median view. **F.** Left endite, projections P2, P3, P4 (asterisk) and P5, anterior view. Abbreviations: **mp,** median projection; **P,** projection. Scale bars: 5 μm (A, B, D–F), 10 μm (C).

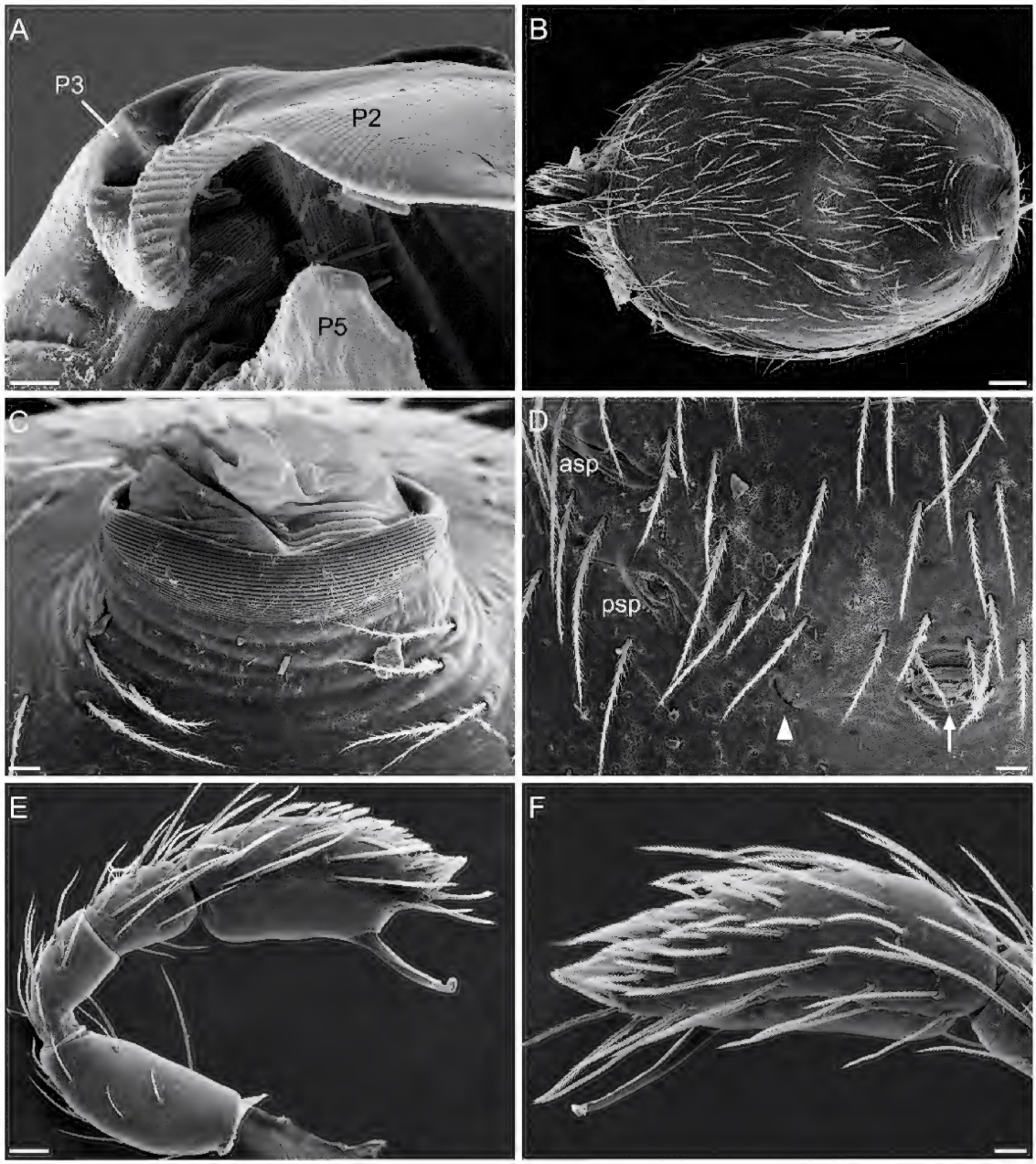


Fig. 40. *Zyngoonops beatriceae*, new species, male. **A.** Left endite, projections P2, P3 and P5, anteroventral view. **B.** Abdomen, ventral view. **C.** Pedicel tube, ventral view. **D.** Epigastric region, ventral view, showing sperm pore (arrow), additional orifice (arrowhead), anterior spiracle (asp) and posterior spiracle (psp). **E.** Pedipalp, prolateral view. **F.** Cymbium, dorsal view. Scale bars: 5 μm (A), 10 μm (C, D, F), 25 μm (E), 50 μm (B).

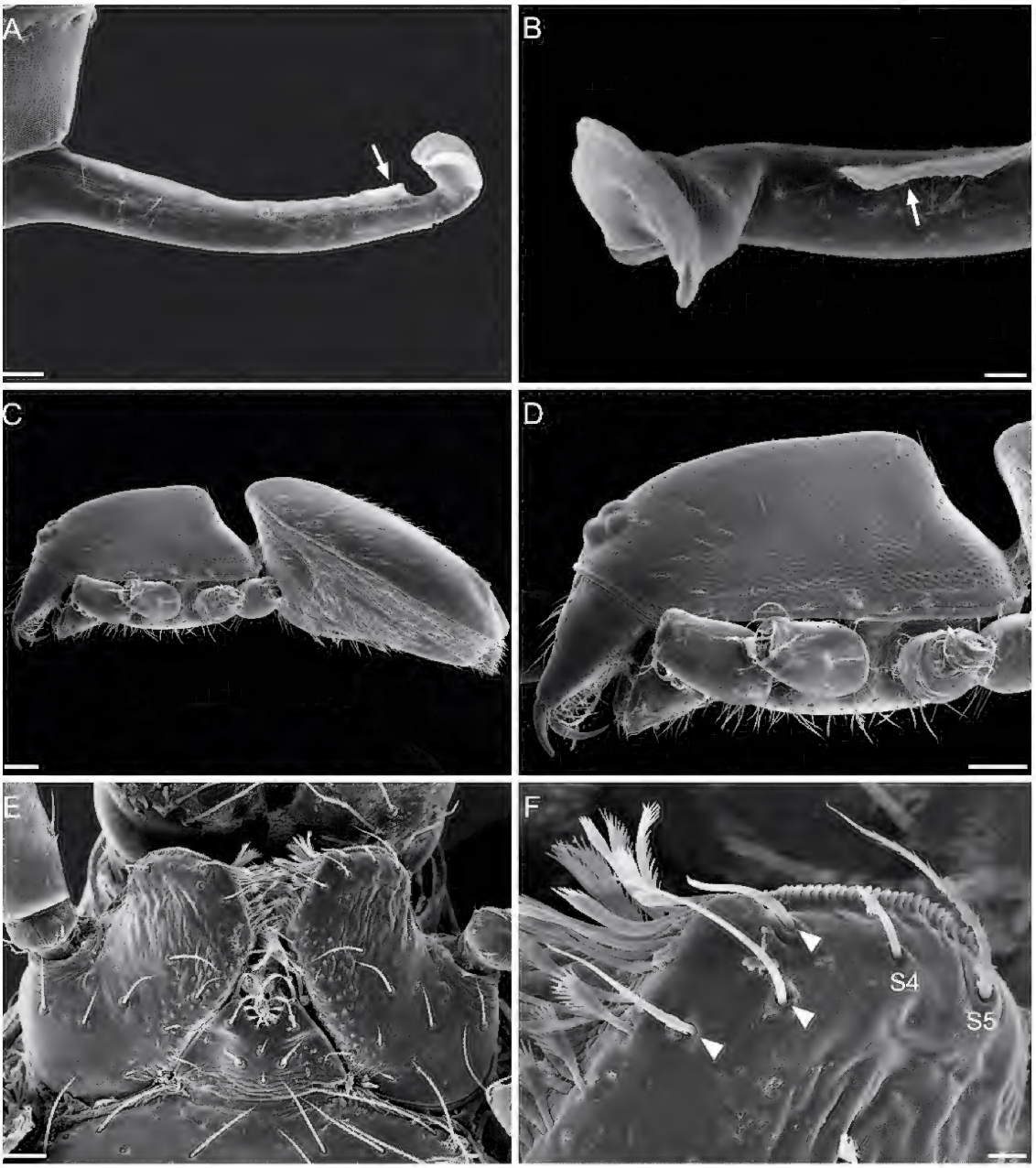


Fig. 41. *Zyngoonops beatriceae*, new species, male (A, B) and female (C–F). **A.** Embolus, prolateral view. Arrow: ridge. **B.** Same, dorsal view. Arrow: ridge. **C.** Habitus, lateral view. **D.** Carapace, lateral view. **E.** Mouthparts, ventral view. **F.** Detail of left endite, showing setae 1–3 (arrowheads) and setae 4–5 (s4–5). Scale bars: 2 μm (B), 5 μm (A, F), 25 μm (E), 100 μm (C, D).

DISTRIBUTION: Known only from the Kivu region, D.R.C. (map 5), where the species is sometimes sympatric with *Z. beatriceae*, *Z. swammerdami* or *Z. chambersi*.

Coxapopha Platnick

Coxapopha Platnick, 2000: 405 (type species by monotypy *Coxapopha diblemma* Platnick).

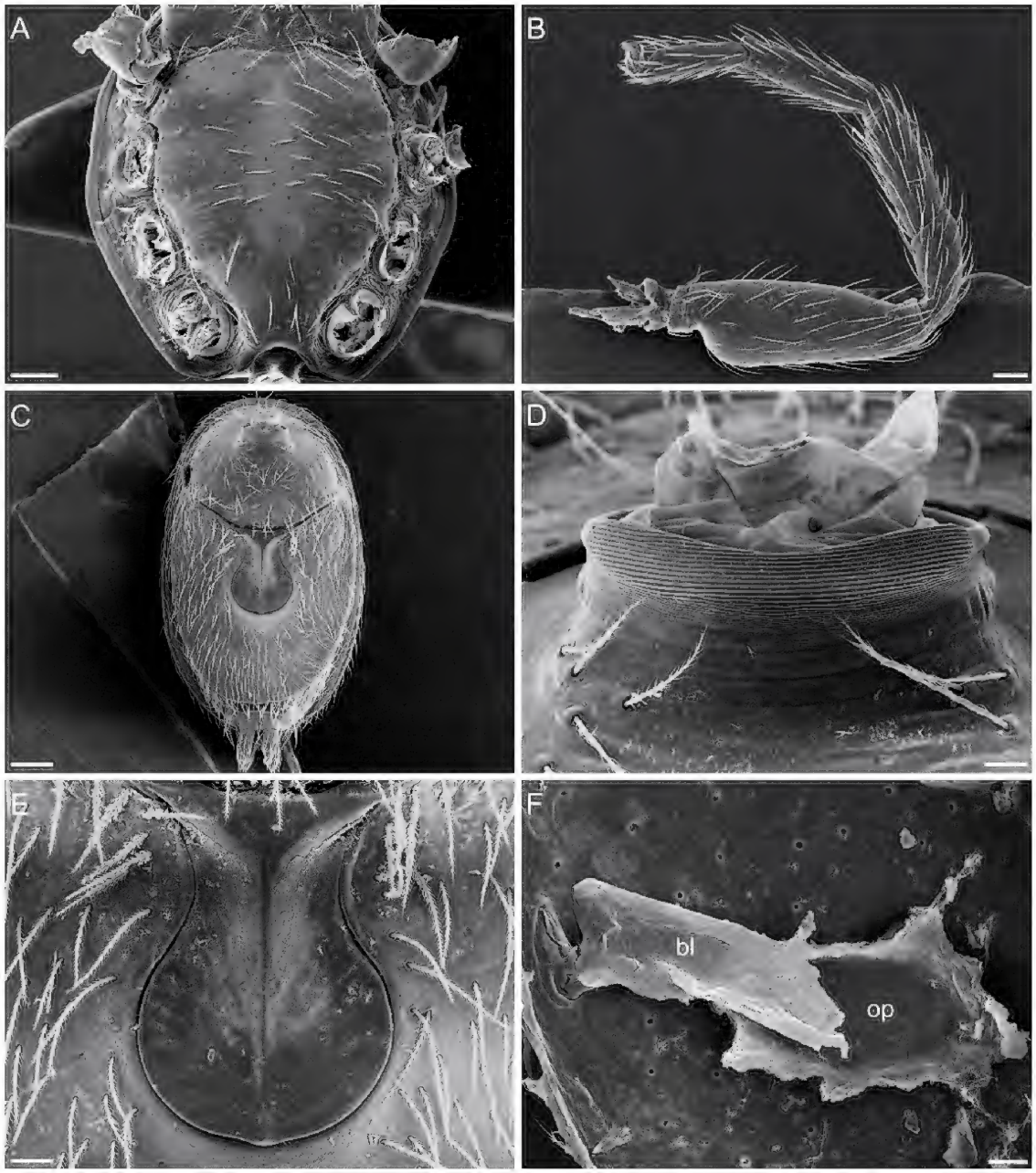


Fig. 42. *Zyngoonops beatriceae*, new species, female. **A.** Sternum, ventral view. **B.** Leg III, prolateral view. **C.** Abdomen, ventral view. **D.** Pedicel tube, ventral view. **E.** Epigastric scape, ventral view. **F.** Booklung (bl) and operculum (op), dorsal view. Scale bars: 10 μm (D, F), 25 μm (B, E), 50 μm (A), 100 μm (C).

Coxapopha diblemma Platnick
Figures 78–85, 106; map 6

Coxapopha diblemma Platnick, 2000: 409, figs. 1–7 (male holotype from Parque Nacional Soberania, Panama, in QM; examined).

DIAGNOSIS: The male differs from congeners in having the sperm pore situated near the tip of a long apophysis (fig. 82A, C, D), and in lacking an apophysis between the sperm pore and the pedicel tube (fig. 81A). In

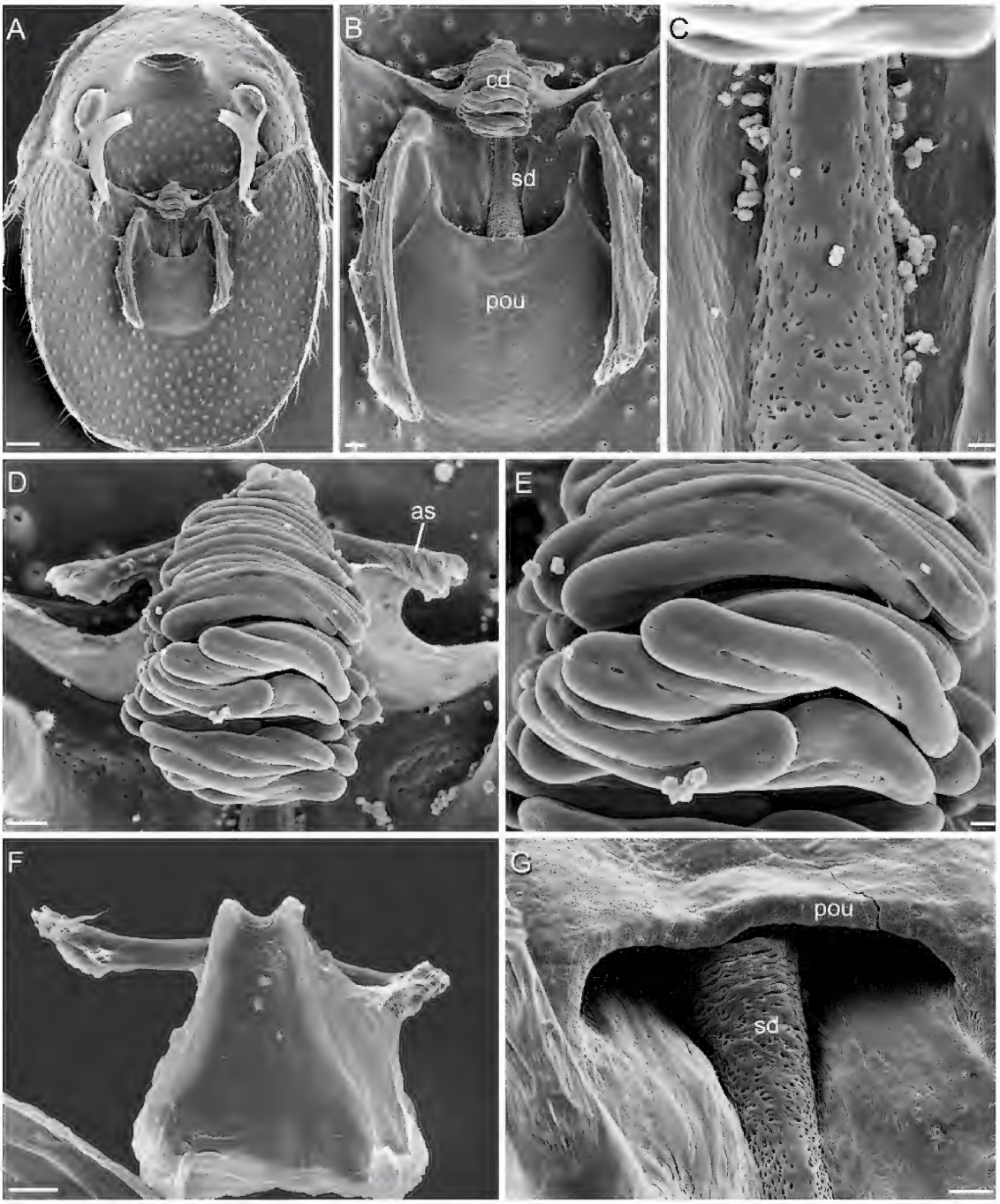


Fig. 43. *Zyngoonops beatriceae*, new species, female. **A.** ES and PES, dorsal view. **B.** Internal genitalia, dorsal view. **C.** Detail of B, showing straight part of duct. **D.** Coiled part of duct, dorsal view. **E.** Detail of D. **F.** Anterior sclerite, posterior view. **G.** Pouch and duct, anterior view. Abbreviations: **as,** anterior sclerite; **cd,** coiled part of duct; **pou,** genital pouch; **sd,** straight part of duct. Scale bars: 2 μm (C, E), 10 μm (B, D, F, G), 50 μm (A).

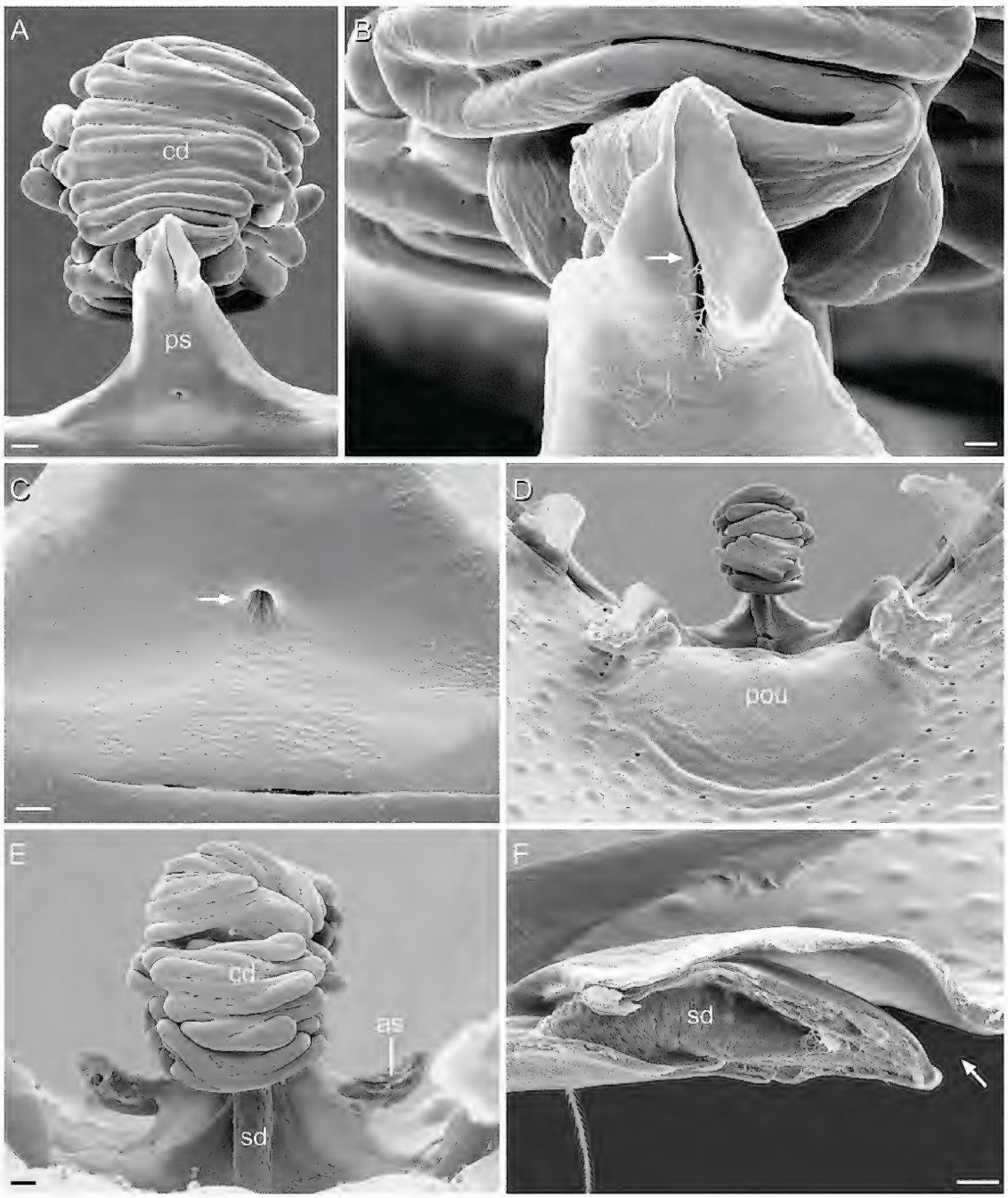


Fig. 44. *Zyngoonops beatriceae*, new species, female. **A.** Posterior sclerite, anterior view. **B.** Detail of A, showing slitlike opening in posterior sclerite (arrow). **C.** Detail of A, showing small opening in posterior sclerite (arrow). **D.** Internal genitalia, posterior view. **E.** Posterior sclerite, posterior view. **F.** Longitudinal section through genital pouch, showing duct. Arrow: entrance to pouch. Abbreviations: **as,** anterior sclerite; **cd,** coiled part of duct; **pou,** genital pouch; **ps,** posterior sclerite; **sd,** straight part of duct. Scale bars: 2 μm (B, C), 5 μm (A, E), 20 μm (D, F).

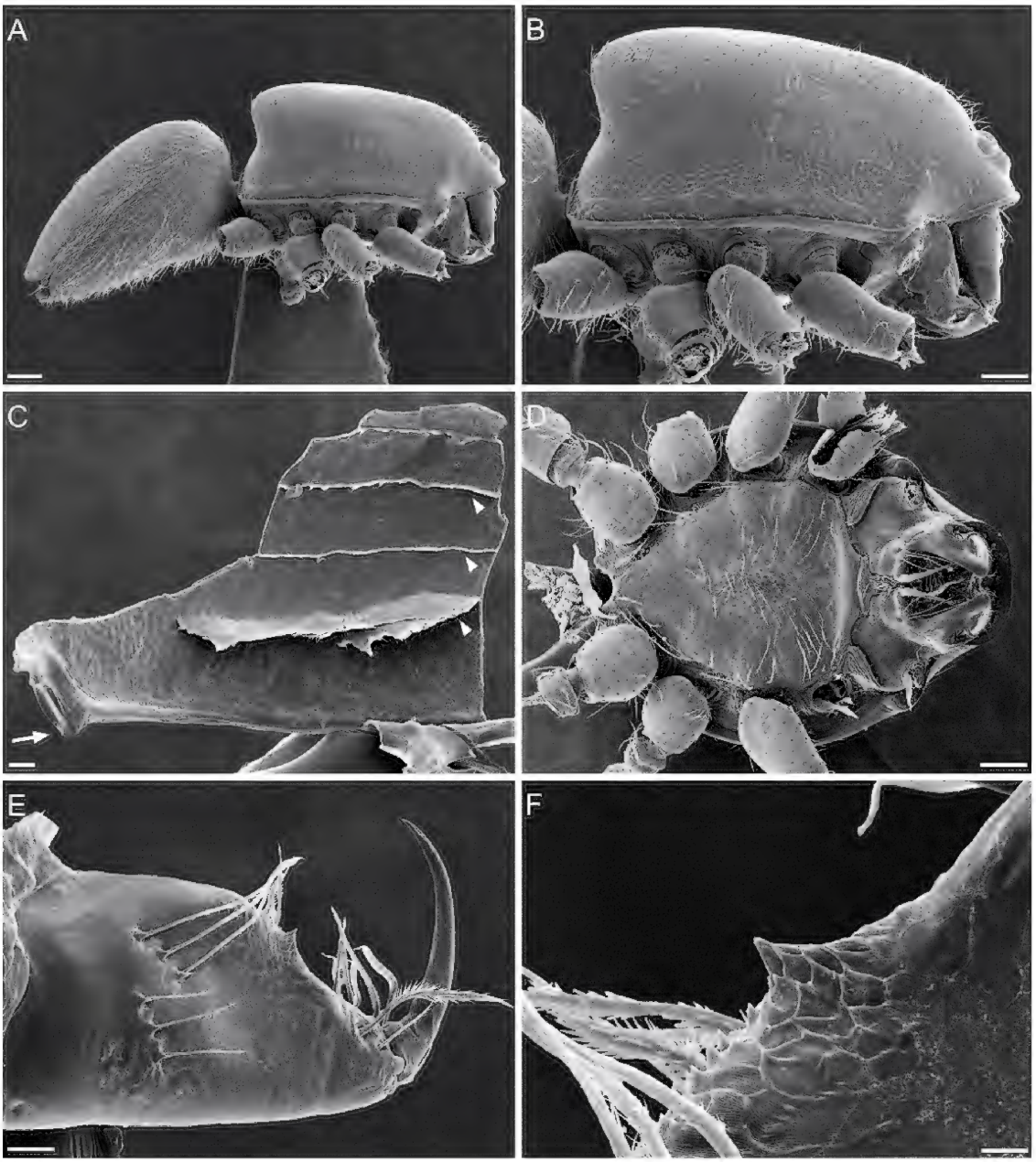
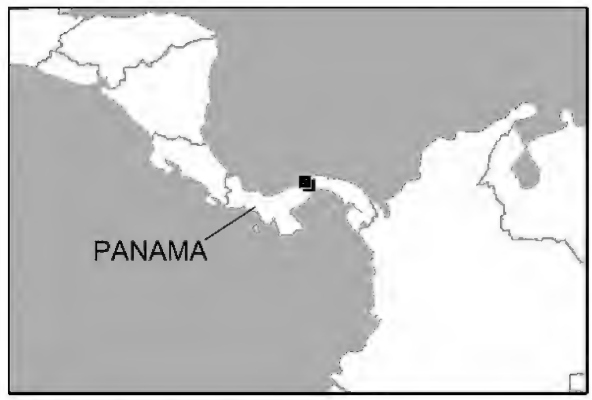


Fig. 45. *Zyngoonops chambersi*, new species, male. **A.** Habitus, lateral view. **B.** Carapace, lateral view. **C.** Carapace wall, inner surface. Arrow: extended anterolateral corner. Arrowheads: ridges. **D.** Carapace, ventral view. **E.** Chelicera, posterior view. **F.** Detail of E, showing cheliceral tooth. Scale bars: 5 μm (F), 30 μm (C, E), 100 μm (A, B, D).

the other species of the genus, the sperm pore is only slightly elevated, and the ventral scutum has a prominent apophysis between the sperm pore and the pedicel tube (R. Ott, personal commun.; Ott and Brescovit, 2004: figs. 13, 29).

MALE (figs. 78–85, 106): TL 1.95. Habitus as in figure 106A, B. Carapace red-brown,



Map 6. Records of *Coxapopha diblemma* (squares).

pars cephalica strongly elevated in lateral view, anteriorly narrowed to 0.5 times its maximum width, with rounded posterolateral corners, posterolateral edge without pits, anterolateral corners with strongly sclerotized, triangular extension, posterolateral surface without spikes, surface of elevated portion of pars cephalica smooth; lateral surfaces with microsculpture on lower part; thorax without depressions, without radiating rows of pits; lateral margin straight, rebordered (figs. 78A–D, 106C, E, F). Clypeus sinuous in front view, very high, ALE separated from edge of carapace by their radius or more, median projection absent, setae present (figs. 78B, 106F). Two small, oval eyes, approximately one diameter apart (figs. 78B, 106F). Sternum pale yellow, slightly wider than long, fused to carapace, median concavity absent, surface finely reticulate, without pits, sickle-shaped structures absent, posterior margin not extending posteriorly of coxae IV, distance between coxae approximately equal, extensions of precoxal triangles present, without posterior hump, setae abundant, without hair tufts (figs. 78E, 106G). Pleural flaps present, small (fig. 80E). Infracoxal grooves present, shallow (the presence of pores could not be established because the grooves were covered by dust); coxal insertions I, II, and III each with two clusters of small openings. Chelicerae orange, anterior face unmodified; one small cheliceral tooth on promargin; a short, apically pointed seta on inner surface of chelicera; promargin flanked by double row of setae (inner and outer row), each row with about five setae, setae of inner row with small cuticular teeth on shaft, outer row consisting of smooth setae; between double row and fang base a long plumose hair; anterior face of paturon with sparse setae (fig. 79A); posterior surface of paturon with three short spines and a row of five long, medially directed setae; fangs without toothlike projections, shape normal, without prominent basal process, tip unmodified. Labium much more heavily sclerotized than sternum, wider than long, with setae (figs. 79B, 106H). Endites: enlarged, median margin short, posteromedian part bulging (figs. 79C, 80D); ventral surface heavily sclerotized except for diagonal band (fig. 106H); median surface with a pocket and two groups of setae (anterior and posterior group; fig. 80D); anterior edge of pocket continues into median projection (fig. 80D); median projection short, directed anteriorly, with a curved anterior extension (figs. 79D, F, 80A, C, D); setae s1–3 relatively short (figs. 79D, F, 80C). Pedicel with one dorsal and one ventral sclerite; dorsal sclerite flat, posteriorly drawn out into a point, not fused to prosoma, without special modifications; ventral sclerite U-shaped, covering ventral and lateral sides of pedicel, anteriorly fused to prosoma, without special modifications. Abdomen ovoid, without long posterior extension, rounded posteriorly, interscutal membrane rows of small sclerotized platelets absent (figs. 80F, 81A, 106D). Booklung covers large, ovoid, without setae, anterolateral edge unmodified (fig. 81F). Posterior spiracles not connected by groove. Pedicel tube short, not

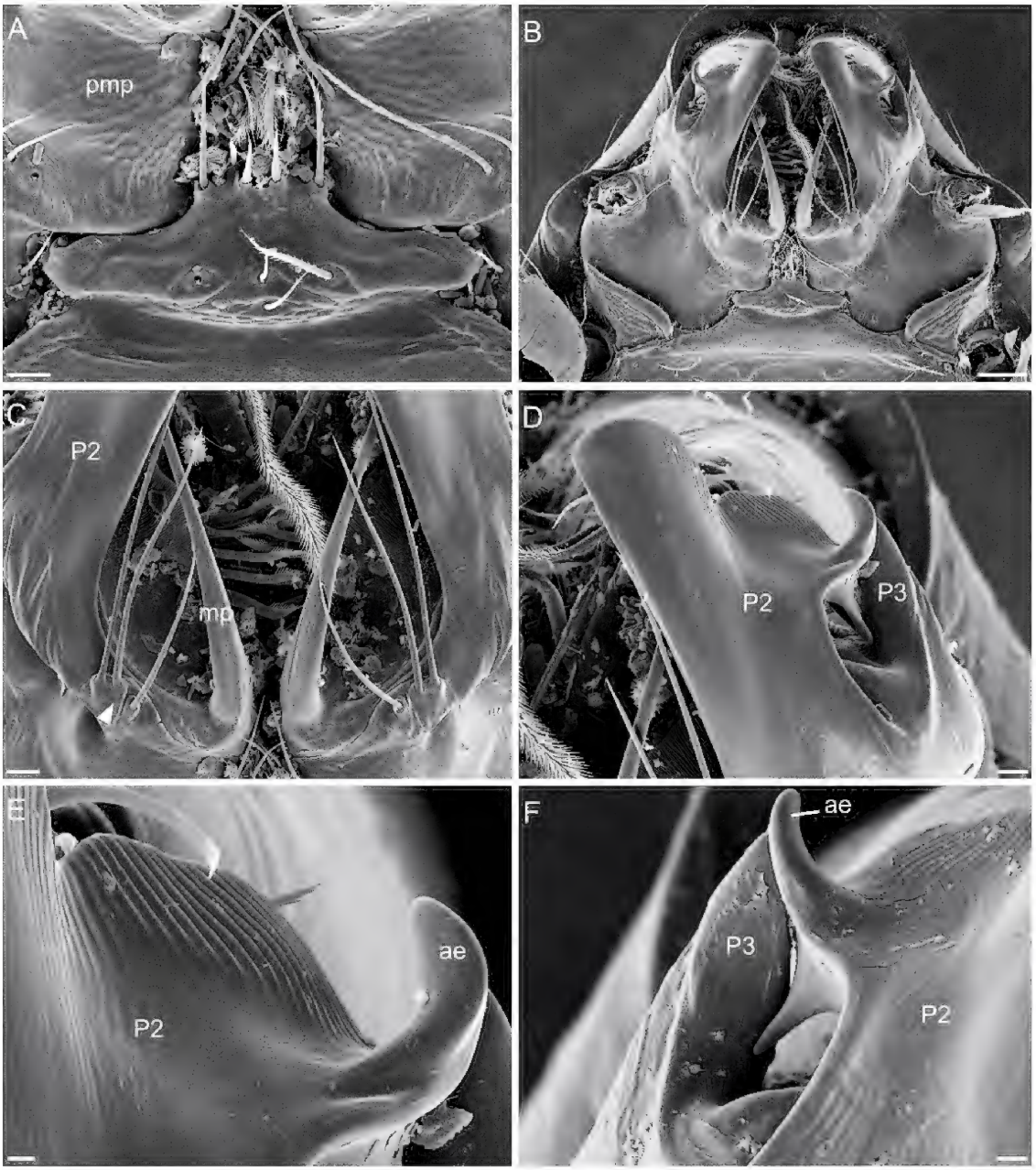


Fig. 46. *Zyngoonops chambersi*, new species, male. **A.** Labium, ventral view. **B.** Mouthparts, ventral view. **C.** Detail of B, showing median projections. Arrowhead: setae 1–3. **D.** Left endite, P2 and P3, ventral view. **E.** Detail of D, showing anterolateral extension of P2. **F.** Right endite, P3, ventral view. Abbreviations: **ae,** anterolateral extension of P2; **mp,** median projection; **P,** projection; **pmp,** posteromedian part of endite. Scale bars: 2 μm (E), 5 μm (F), 10 μm (A, C, D), 50 μm (B).

ribbed, without triangular extensions, without fringe of setae, with crest-shaped apophysis (see below). Scuto-pedicel region without ridges or denticles, plumose hairs absent, matted setae on anterior ventral abdomen in pedicel area absent (fig. 81E, F). DS strongly sclerotized, yellow-brown, without color pattern, covering full length of abdomen, no soft

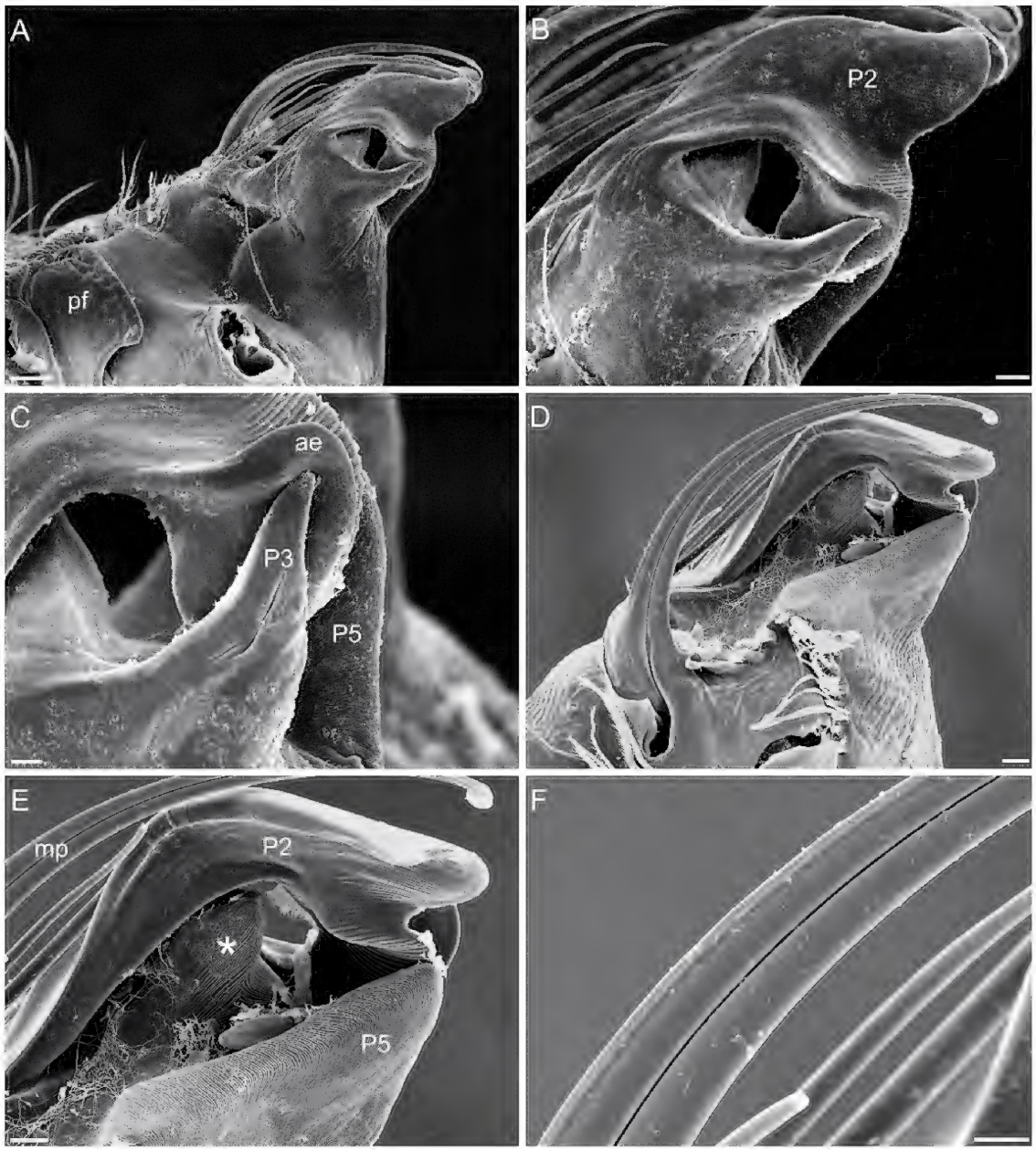


Fig. 47. *Zyngoonops chambersi*, new species, male. **A.** Endites, lateral view. **B.** Left endite, P2, lateral view. **C.** Left endite, P3, lateral view. **D.** Right endite, median view. **E.** Right endite, projections P2, P4 (asterisk) and P5, median view. **F.** Detail of D, showing median projection. Abbreviations: **ae,** anterolateral extension of P2; **mp,** median projection; **P,** projection; **pf,** pleural flap. Scale bars: 5 μm (C, F), 10 μm (B, D, E), 30 μm (A).

tissue visible from above, not fused to ES, middle surface reticulate, sides reticulate, anterior half without projecting denticles (figs. 81A, B, 106A, B). ES and PES fused into a large ventral scutum (figs. 80F, 106D); ventral scutum strongly sclerotized, yellow, covering nearly full length of abdomen, with two apophyses, anterior apophysis crest

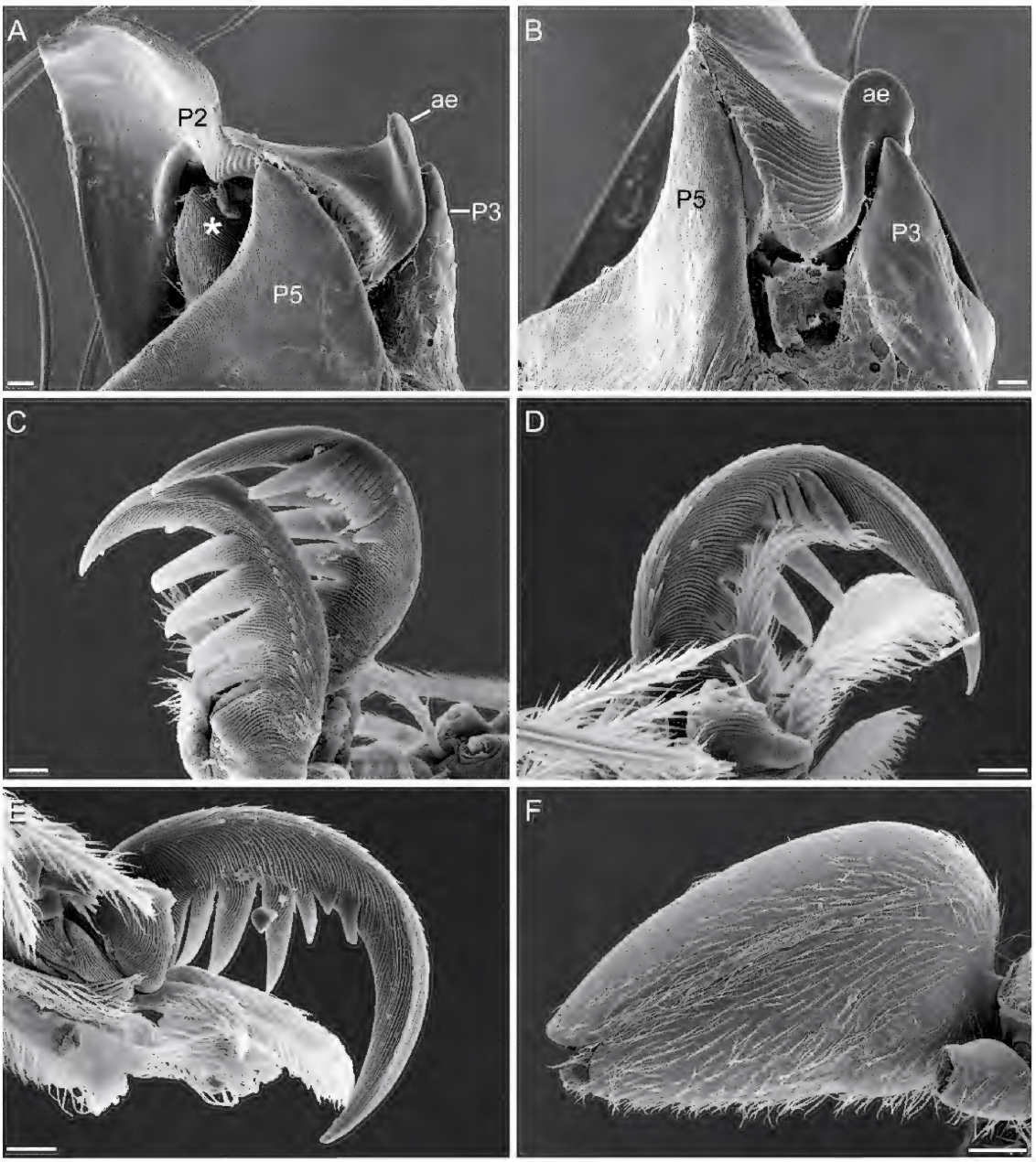


Fig. 48. *Zyngoonops chambersi*, new species, male. **A.** Right endite, projections P2, P3, P4 (asterisk) and P5, anterior view. **B.** Right endite, projections P2, P3 and P5, anterolateral view. **C.** Claws, leg II, lateral view. **D.** Retroclaw, leg III, median surface. **E.** Same, leg IV. **F.** Abdomen, lateral view. Abbreviations: **ae,** anterolateral extension of P2; **P,** projection. Scale bars: 5 μm (A–E), 100 μm (F).

shaped, triangular, situated near anterior margin of pedicel tube (fig. 81A, C–F), posterior apophysis long, horn shaped, bearing sperm pore (figs. 81A, C, 82A, C, D). Small lateral sclerites absent. Lateral apodemes long, posteriorly directed (fig. 106D). Spinneret scutum present, incomplete ring, with fringe of needlelike setae. Interscutal membrane with setae. Colulus present, sporting two setae. ALS two segmented, with one

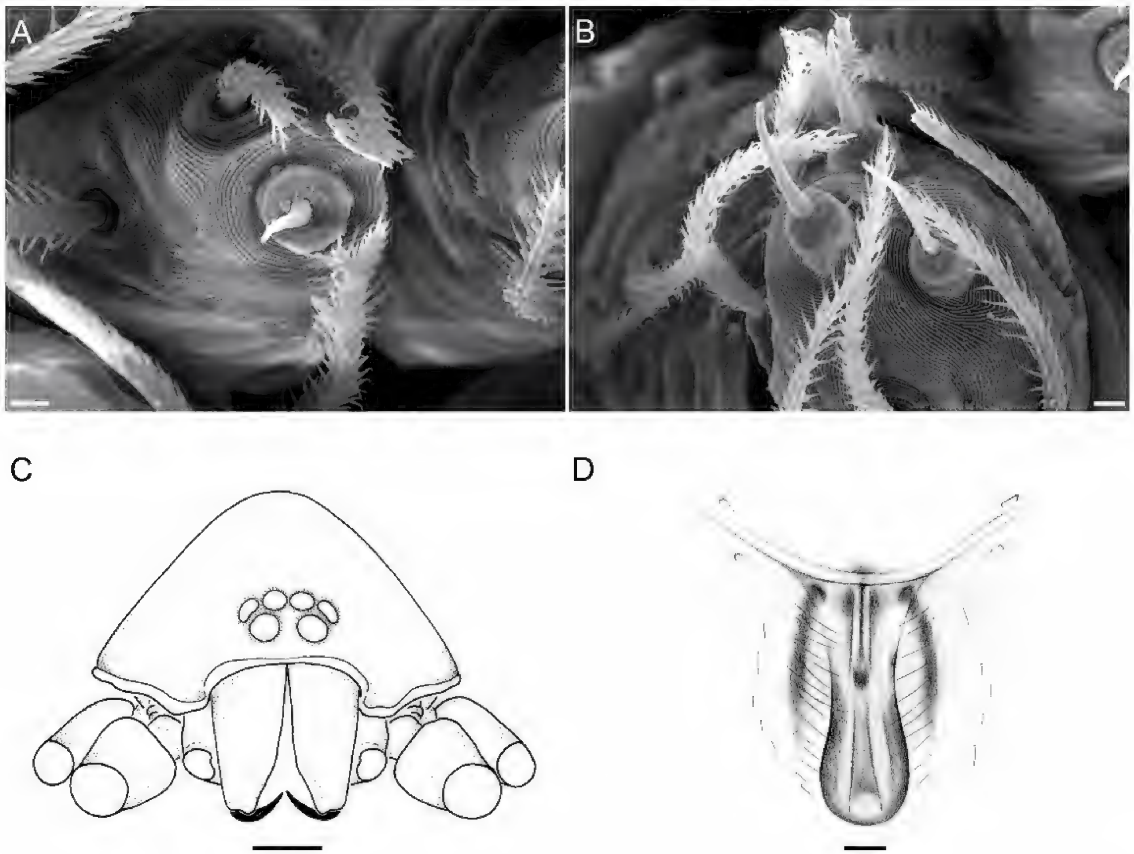


Fig. 49. *Zyngoonops chambersi*, new species, male (A, B) and female (C, D). **A.** PMS, posterior view. **B.** PLS, posterior view. **C.** Carapace, anterior view. **D.** Epigastric region, ventral view. Scale bars: 2 μm (A, B), 50 μm (D), 100 μm (C).

major ampullate gland spigot and two piriform gland spigots (fig. 82E); PMS single segmented, digitiform, with two spigots; PLS two segmented, with three spigots. Legs yellow, without color pattern, patella plus tibia I shorter than carapace; coxae IV with a hand-shaped apophysis that bears four (holotype) or five (other specimen) peg setae (fig. 84C, D); femur IV not thickened, same size as femora I–III; tibiae III and IV with a group of specialized setae on ventral apex (fig. 84A, B). Small, oval glands on femora, patellae, tibiae, and metatarsi (fig. 83C). Leg spination (only surfaces bearing spines listed, all spines relatively short): patellae: I p0-1-0; tibiae: I v2-2-2; II v0-1r-0; metatarsi: I v0-2-0 (figs. 82F, 83A, B). Tarsi I to IV claws examined in detail; superior claws with 4–5 large, proximally situated teeth on lateral surfaces, about 18–25 small, distally situated teeth on median surfaces; inferior claw absent (fig. 83F, G). Trichobothria examined with SEM; each leg with four dorsal trichobothria: one on proximal tibia, two on distal tibia, one on distal metatarsus; hairs plumose, bothrium as in figure 83D, aperture internal texture gratelike. Tarsal organ exposed; receptors could not be studied because they were obscured by dust. Epigastric region with sperm pore small, elliptical, wider than long, situated near tip of posterior apophysis (fig. 82B, D); a pair of additional orifices mesad of posterior spiracles (fig. 82B). Palps not strongly sclerotized, right and left palps symmetrical; trochanter without ventral projection; femur two or more times as long as trochanter, without posteriorly rounded lateral dilation, attaching to patella basally; patella shorter than femur, not enlarged, without prolateral row of ridges, setae

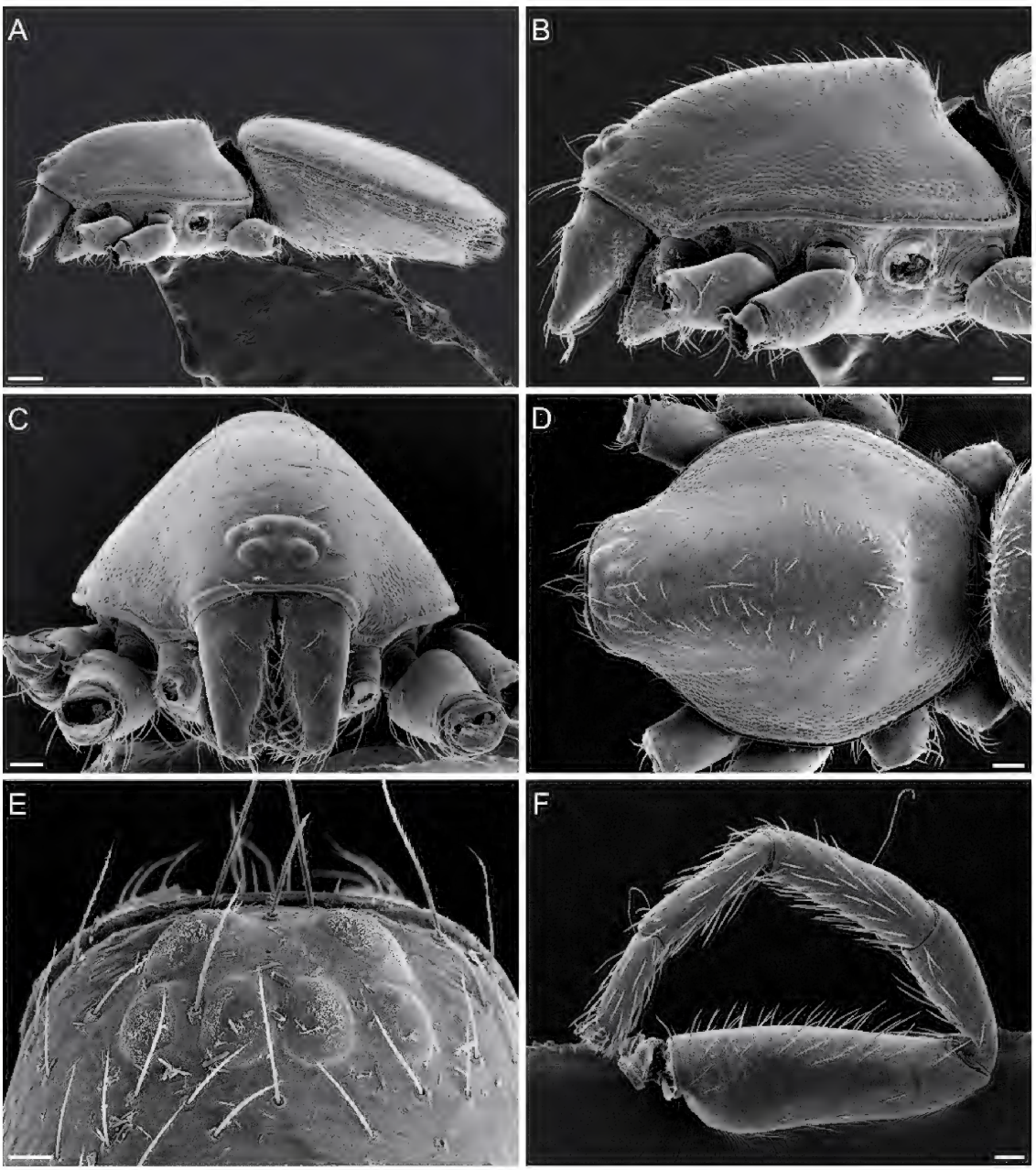


Fig. 50. *Zyngoonops chambersi*, new species, female. **A.** Habitus, lateral view. **B.** Carapace, lateral view. **C.** Same, anterior view. **D.** Same, dorsal view. **E.** Eyes, dorsal view. **F.** Leg I, lateral view. Scale bars: 20 μm (E, F), 50 μm (B–D), 100 μm (A).

unmodified; tibia with three dorsal trichobothria; cymbium fused with bulb but seam still visible distally, extending slightly beyond distal tip of bulb; bulb shorter than cymbium, elongated (fig. 84E, F); embolus tubelike, less than half as long as bulb, with distally a slitlike opening (fig. 85A, B, E, F); conductor situated prolaterally of embolus, slightly longer than embolus, with dorsally a conspicuous rodlike projection (dorsal projection; fig. 85).

FEMALE: Unknown.

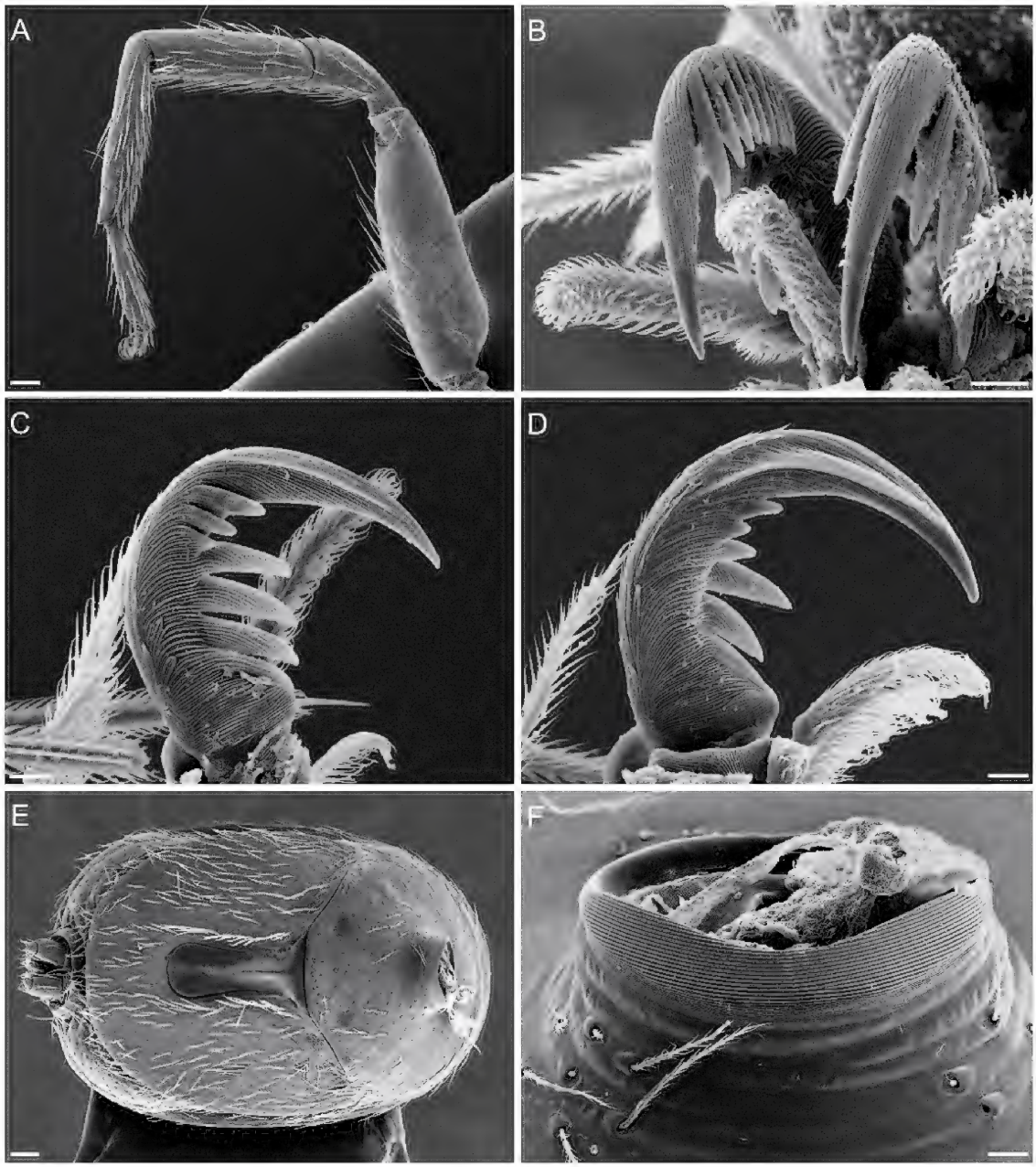


Fig. 51. *Zyngoonops chambersi*, new species, female. **A.** Leg IV, lateral view. **B.** Claws, leg II, anterior view. **C.** Proclaw, leg III, median surface. **D.** Same, leg IV. **E.** Abdomen, ventral view. **F.** Pedicel tube, ventral view. Scale bars: 5 μm (B–D), 10 μm (F), 30 μm (A), 50 μm (E).

MATERIAL EXAMINED: **Panama:** Parque Nacional Soberania, 09°04′N, 079°41′W, Aug. 7, 1983, litter, V.E. Davies (PBI_OON 4735, QM S52152), 1 male (holotype). San Lorenzo Protected Area, 09°16′N, 079°58′W, Sept. 22, 2003 to Oct. 31, 2004, IBISCA project (PBI_OON 33138, MRAC), 1 male (used for SEM).

DISTRIBUTION: Known only from Panama (map 6).

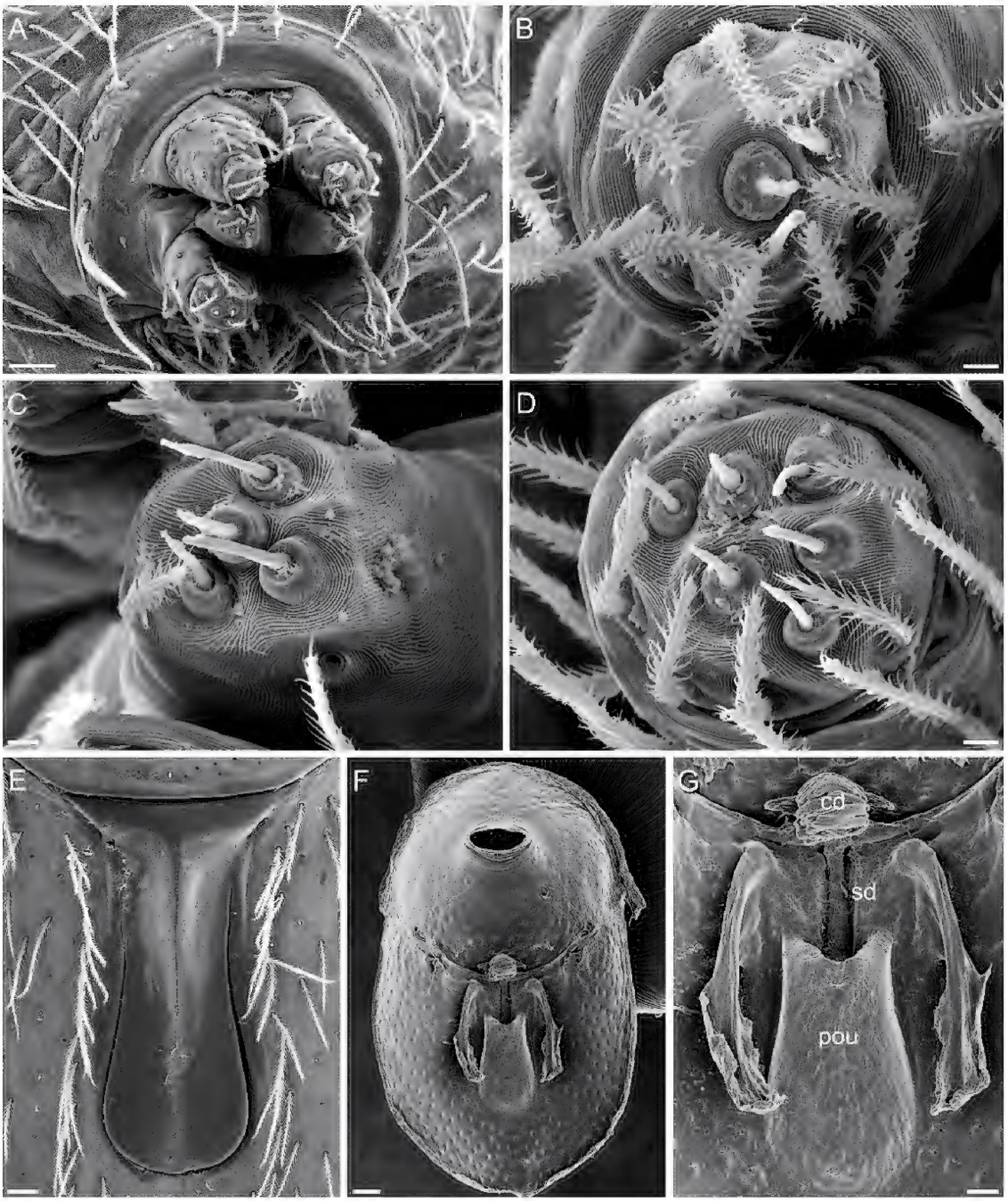


Fig. 52. *Zyngoonops chambersi*, new species, female. **A.** Spinnerets, posterior view. **B.** ALS, posterior view. **C.** PMS, posterior view. **D.** PLS, posterior view. **E.** Epigastric scape, ventral view. **F.** ES and PES, dorsal view. **G.** Internal genitalia, dorsal view. Abbreviations: **cd,** coiled part of duct; pou, genital pouch; **sd,** straight part of duct. Scale bars: 3 μm (B–D), 20 μm (A, E, G), 50 μm (F).

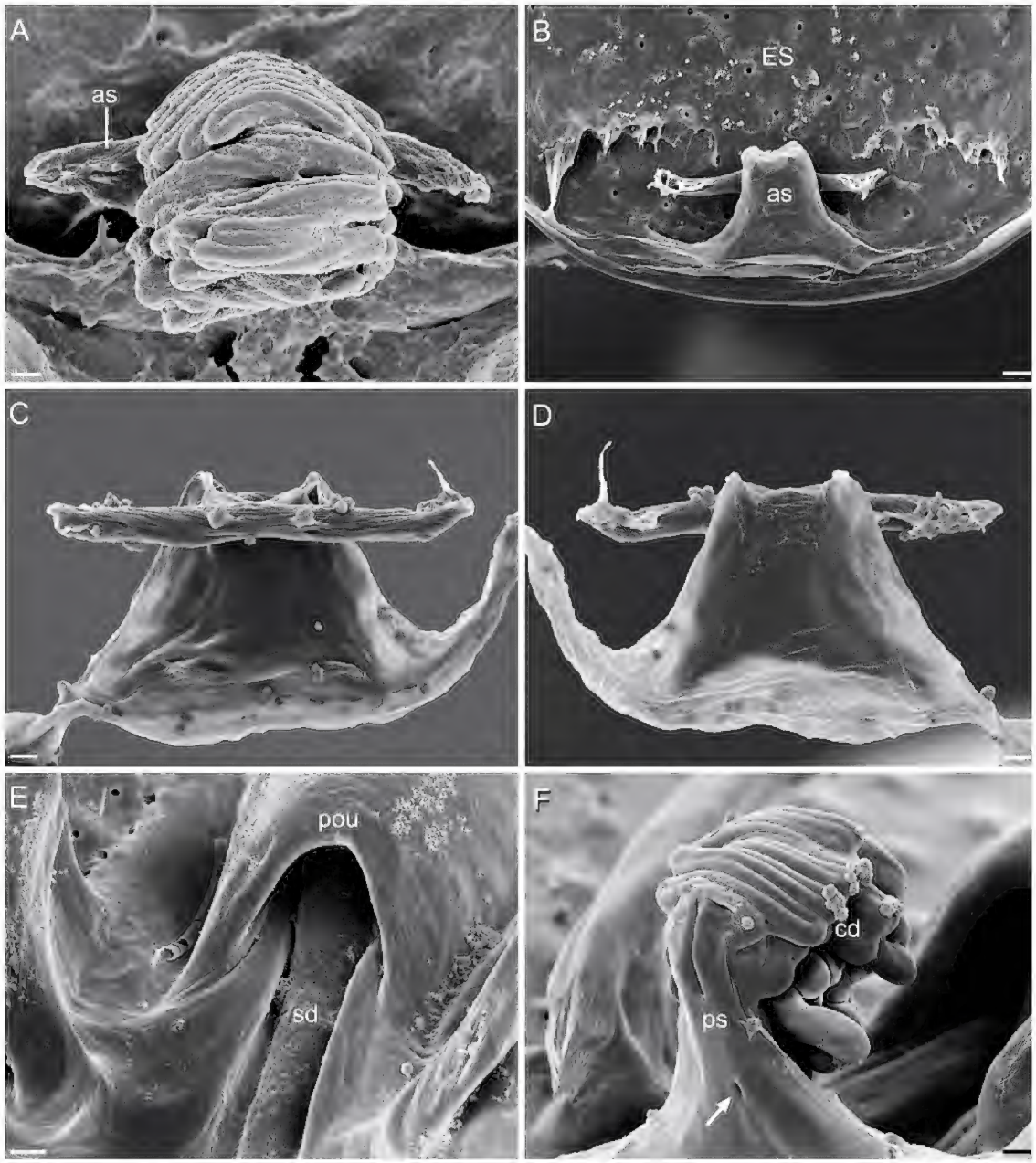


Fig. 53. *Zyngoonops chambersi*, new species, female. **A.** Coiled part of duct, dorsal view. **B.** ES and anterior sclerite, posterior view. **C.** Anterior sclerite, anterior view. **D.** Same, posterior view. **E.** Pouch and duct, anterior view. **F.** Posterior sclerite, anterolateral view. Arrow: small opening. Abbreviations: **as,** anterior sclerite; **cd,** coiled part of duct; **pou,** genital pouch; **ps,** posterior sclerite; **sd,** straight part of duct. Scale bars: 5 μm (A, C, D, F), 10 μm (B, E).

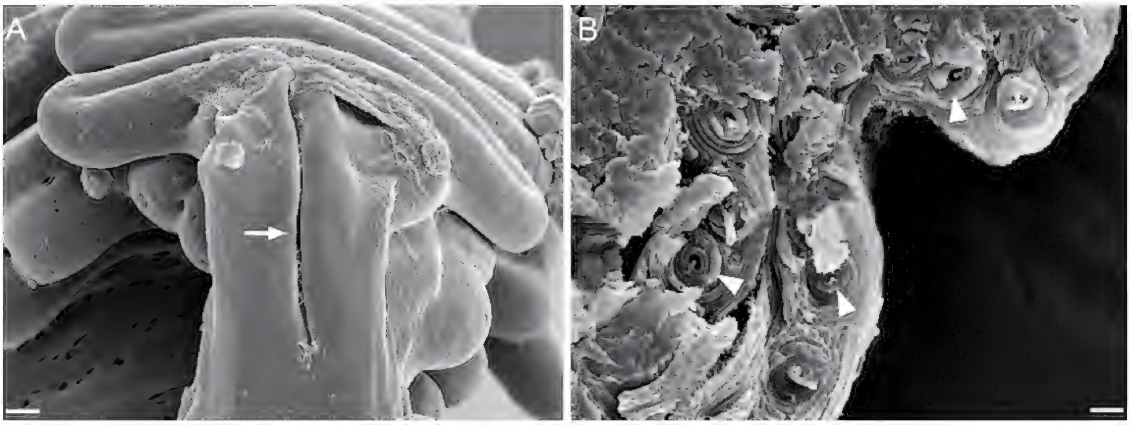


Fig. 54. *Zyngoonops chambersi*, new species, female. **A.** Slitlike opening in posterior sclerite (arrow). **B.** Section through coiled part of duct, showing numerous small, round structures (presumably cross sections through the duct). Arrowheads highlight some of the round structures. Scale bars: 1 μm (B), 2 μm (A).

FEMALE GENITAL MORPHOLOGY OF *COXAPOPHA*

The female genitalia of *Coxapopha* have never been examined by SEM, due to a scarcity of specimens. Recently, Norman Platnick and Nadine Dupérré discovered two new female specimens and kindly made them available for study. These specimens allow, for the first time, a detailed description of the female genitalia.

The specimens were collected close to the type locality of *C. yuyapichis* Ott and Brescovit (2004) and probably belong to this species. However, a definite species assignment is not possible, for all specimens of *C. yuyapichis* are currently missing (C. Rheims, personal commun.). The specimens are therefore referred to as "*Coxapopha* sp." Specimen data is as follows: Peru: Ucayali, Bosque Nacional A. von Humboldt, 8.67 km Pucallpa, 8°23′S, 74°27′W, July 30, 1986, Silva, Museo de Historia Natural, Universidad Nacional Mayor de San Marcos (MUSM-ENT 05001481), 1 female (abdomen studied by SEM; all images depict this specimen). Cusco, Rio Camisea, Cashiari 3, 11°52′57″S, 72°39′02″W, 690 m, Nov.–Dec., 1997, J. Duárez and S. Córdova (MUSM-ENT 05001457), 1 female (specimen intact, not studied by SEM).

The specimens have well-developed abdominal scuta (figs. 86A, B, 105I). The postepigastric scutum has a triangular epigastric scape (figs. 86C–F, 105J), the posterior

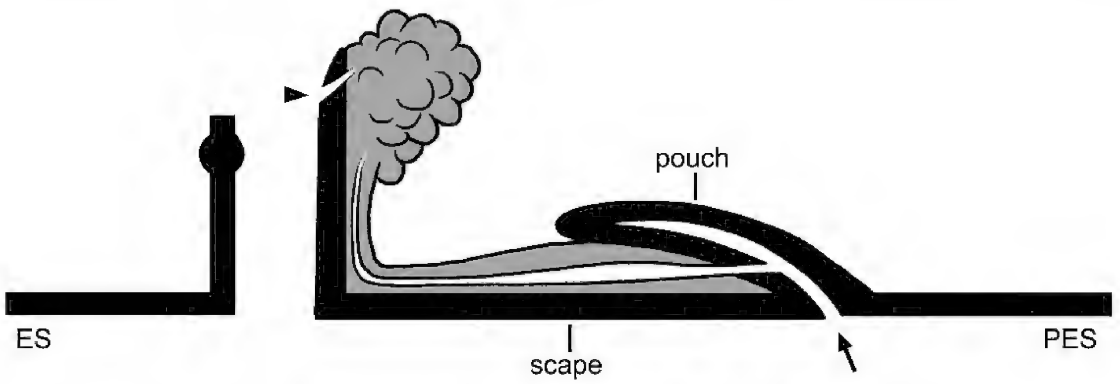


Fig. 55. Schematic drawing of the internal female genitalia of *Zyngoonops chambersi*, new species. Genital duct in grey; lumen only depicted in straight part. Arrow: entrance to pouch. Arrowhead: slitlike opening in posterior sclerite.

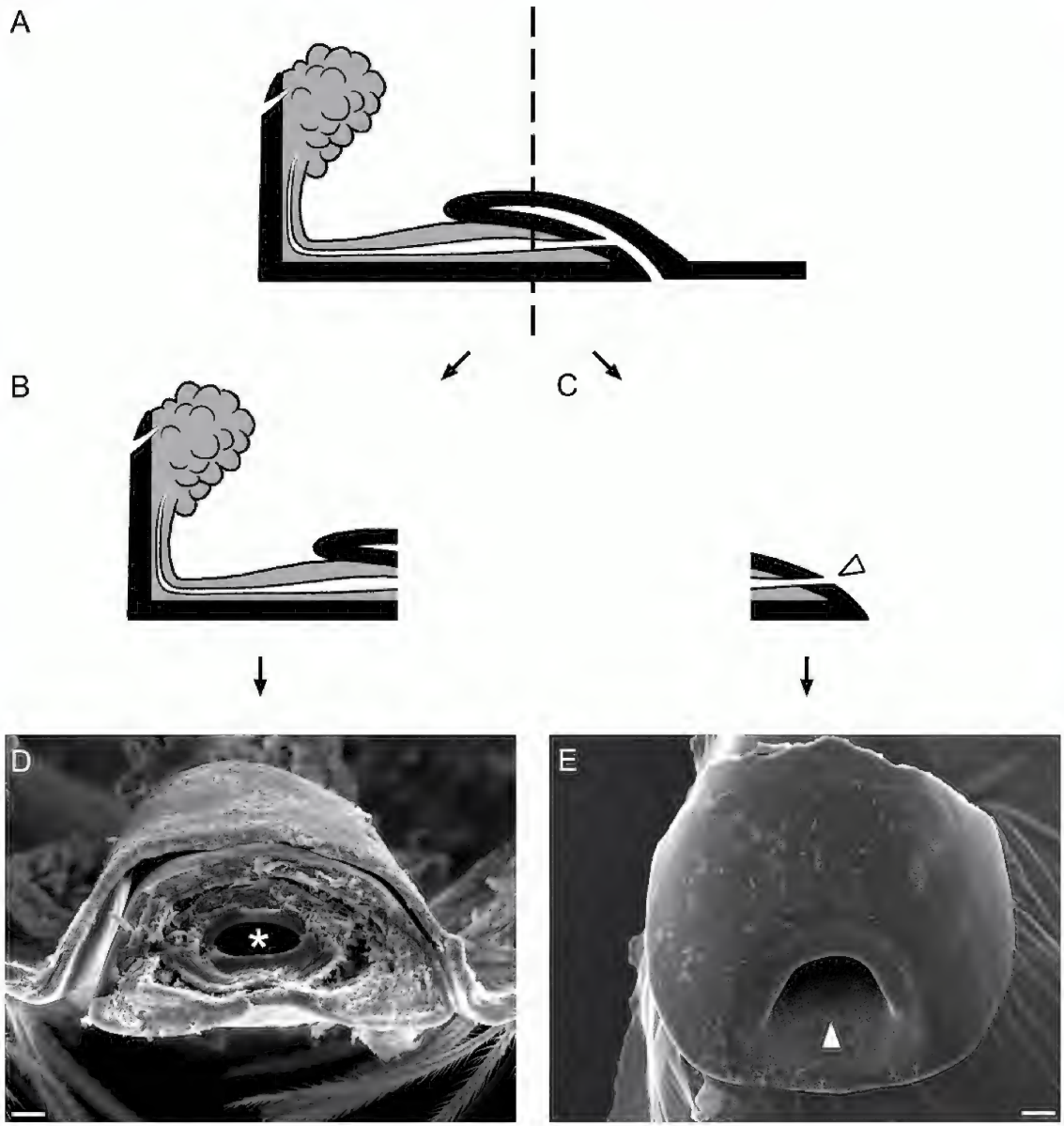


Fig. 56. *Zyngoonops chambersi*, new species, internal female genitalia. The proximal part of the genital duct is covered by the pouch (**A**). To study this part of the duct, the genitalia were sectioned transversally at the level of the dashed line. This resulted in the parts **B** and **C** (arrowhead: copulatory opening in ventral wall of pouch). **D.** A posterior view on part B shows the lumen of the duct (asterisk). **E.** A dorsal view on part C shows the copulatory opening (arrowhead). Scale bars: 10 μm.

tip of which is elevated (fig. 86E, F). The ventral surface of the scape shows a narrow, longitudinal slit (fig. 86D). The posterior end of the slit is slightly widened (fig. 86F); this part of the slit may function as the copulatory opening. The internal genitalia include a genital duct, two lateral apodemes, and two uterine sclerites (figs. 87, 88, 105K). There is no genital pouch. The anterior uterine sclerite is T-shaped (fig. 88E, F). The posterior uterine sclerite has a slitlike opening in its anterior surface (figs. 87D, 88C, D). The

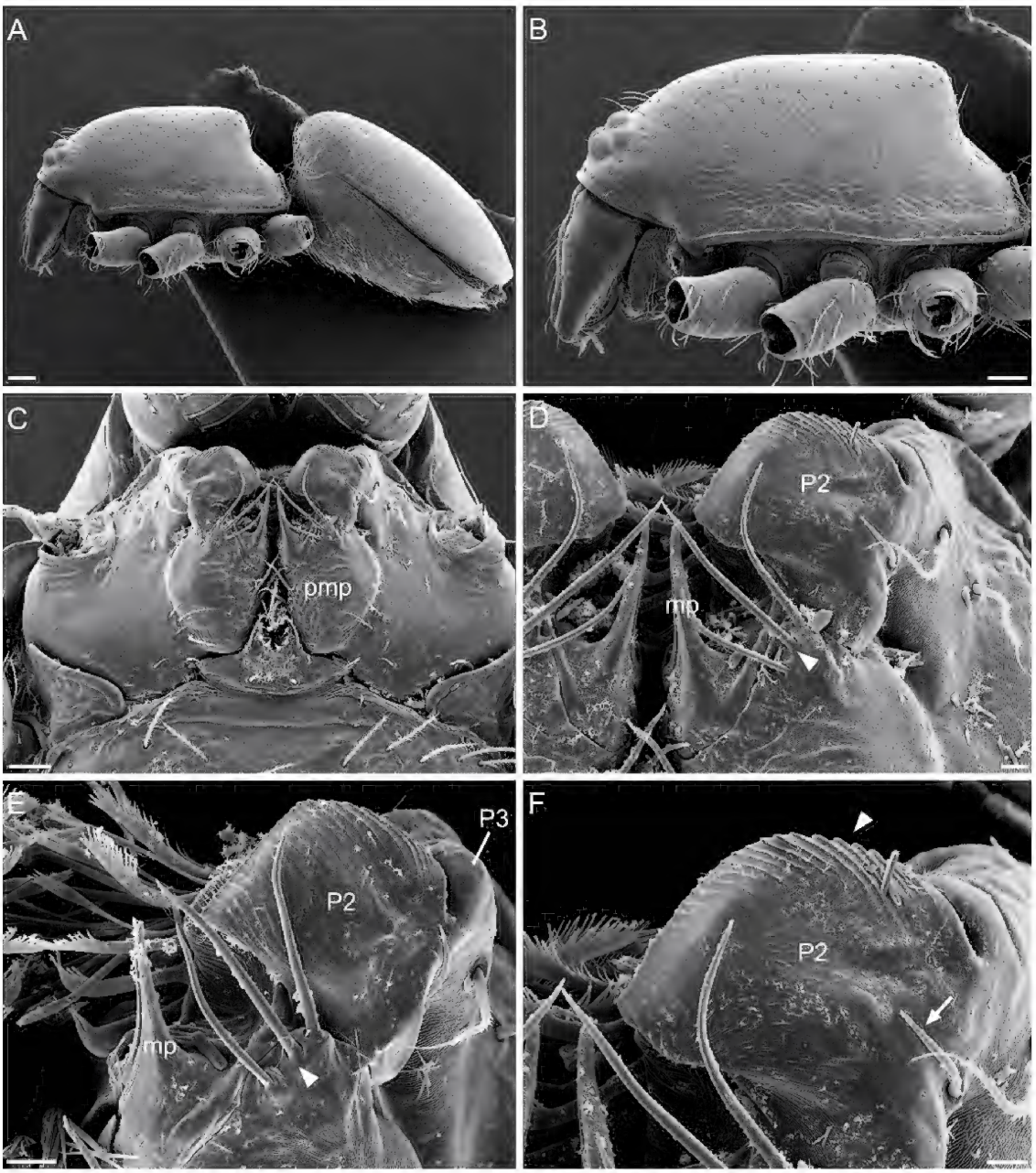


Fig. 57. *Zyngoonops swammerdami*, new species, male. **A.** Habitus, lateral view. **B.** Carapace, lateral view. **C.** Mouthparts, ventral view. **D.** Left endite, median projection and P2, ventral view. Arrowhead: setae 1–3. **E.** Same, other specimen. Arrowhead: setae 1–3. **F.** Left endite, P2, ventral view. Arrowhead: serrated edge. Arrow: seta 4. Abbreviations: **mp,** median projection; **P,** projection; **pmp,** posteromedian part of endite. Scale bars: 5 μm (D–F), 20 μm (C), 50 μm (A, B).

genital duct ascends along the posterior uterine sclerite (fig. 88A, B).

The spinnerets were also scanned (fig. 89). The ALS have one major ampullate gland spigot and two piriform gland spigots (fig. 89B), the PMS have six spigots (fig. 89C), and the PLS have 12 spigots (fig. 89D). The colulus bears two setae (fig. 89A).

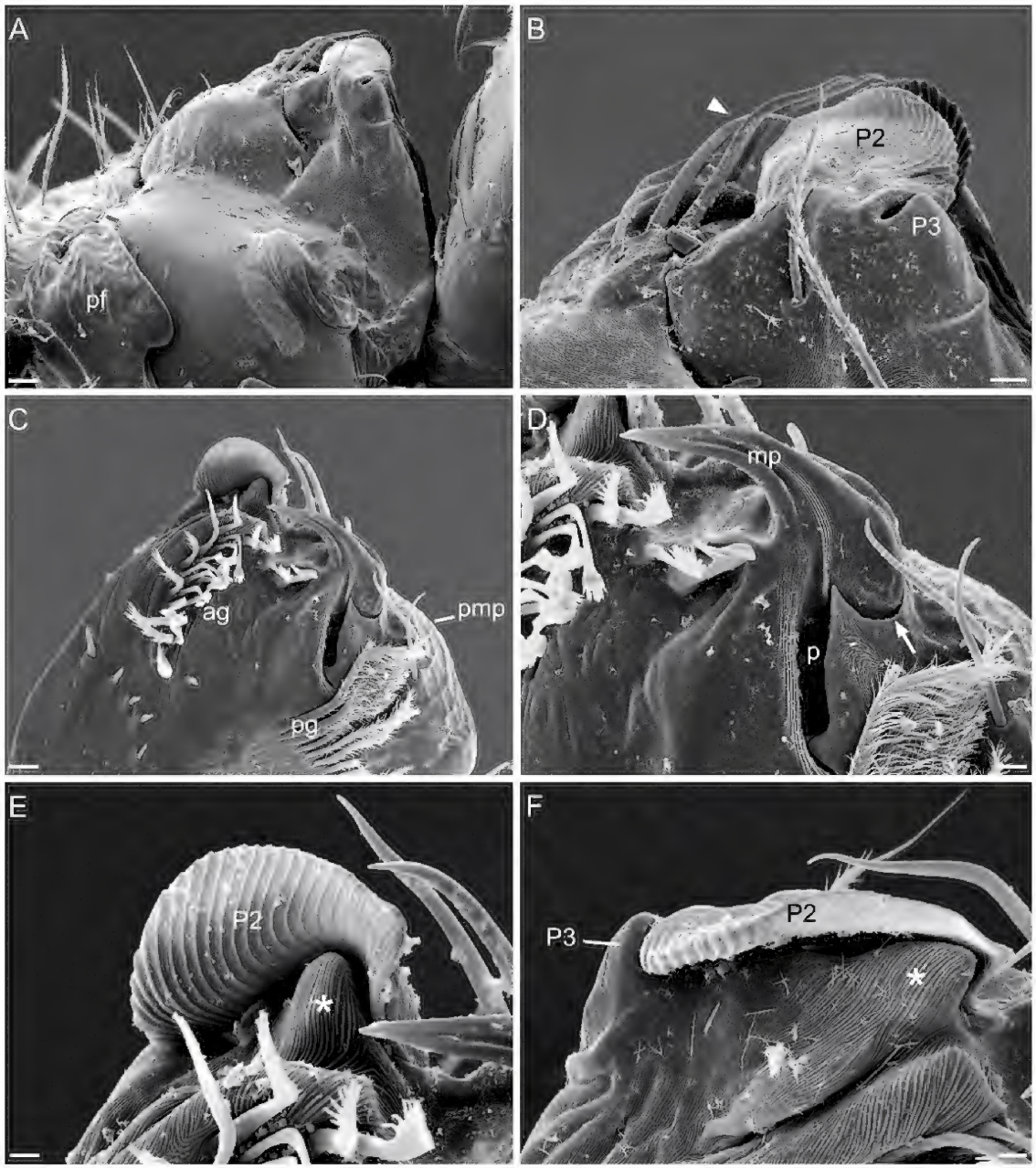


Fig. 58. *Zyngoonops swammerdami*, new species, male. **A.** Endites, lateral view. **B.** Left endite, P2 and P3, lateral view. Arrowhead: setae 1–3. **C.** Left endite, median view. **D.** Left endite, median projection, median view. Arrow: groove. **E.** Left endite, P2 and P4 (asterisk), median view. **F.** Same, medioventral view. Abbreviations: **ag,** anterior group of setae; **mp,** median projection; **P,** projection; **p,** pocket; **pf,** pleural flap; **pg,** posterior group of setae; **pmp,** posteromedian part of endite. Scale bars: 2 μm (E, F), 5 μm (B, D), 10 μm (A, C).

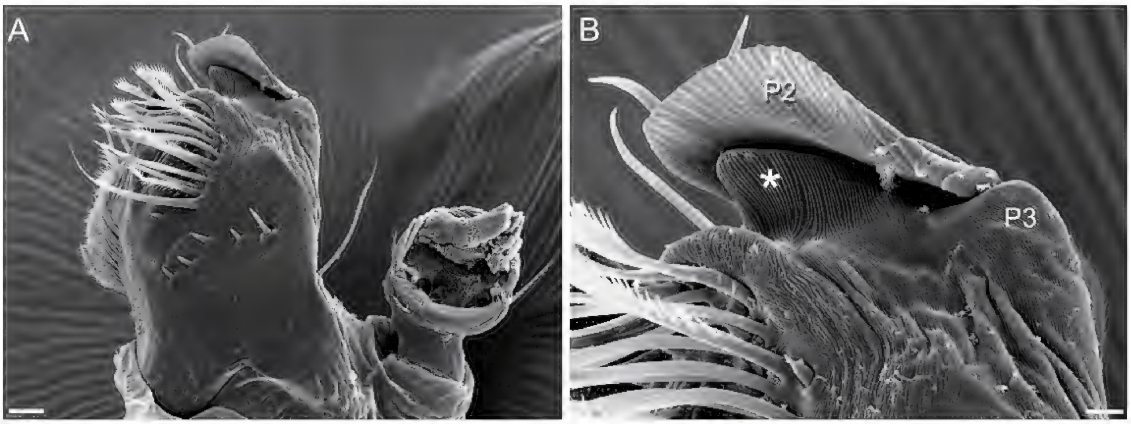


Fig. 59. *Zyngoonops swammerdami*, new species, male. **A.** Right endite, anterior view. **B.** Detail of A, showing projections P2, P3 and P4 (asterisk). Scale bars: 3 μm (B), 10 μm (A).

PHYLOGENETIC ANALYSIS OF *ZYNGOONOPS*

Taxon Sampling

The main goals of the current analysis are: (1) to test the monophyly of *Zyngoonops*, and (2) to reconstruct the species-level phylogeny of the genus. All known species of *Zyngoonops* are included in the analysis with the exception of *Z. walcotti*, which cannot be studied in detail due to the limited number of available specimens. Five outgroups have been selected: *Antoonops corbulo* Fannes and Jocqué (2008; fig. 90), *A. nebula* Fannes and Jocqué (2008; figs. 91–94), *Coxapopha diblemma* (figs. 78–85, 106), *Melchisedec thevenot* Fannes (2010b; figs. 95, 96), and *Oonops pulcher* Templeton (fig. 97). The first three species belong to the *Zyngoonops* group (see Introduction). The last two species are presumably only distantly related to *Zyngoonops*. *Melchisedec thevenot* shares with the *Zyngoonops* group a heavily armored abdomen, but its morphology is otherwise very different (Fannes, 2010b; figs. 95, 96). The soft-bodied species *Oonops pulcher* shows very few similarities with *Zyngoonops* or the *Zyngoonops* group (Platnick and Dupérré, 2009; fig. 97).

Platnick and Dupérré (2010b) have suggested that the armored oonopids form a monophyletic group; the trees were therefore rooted on the soft-bodied *O. pulcher*. The phylogenetic relationships within the *Zyngoonops* group do not change when the trees are rooted on *M. thevenot*.

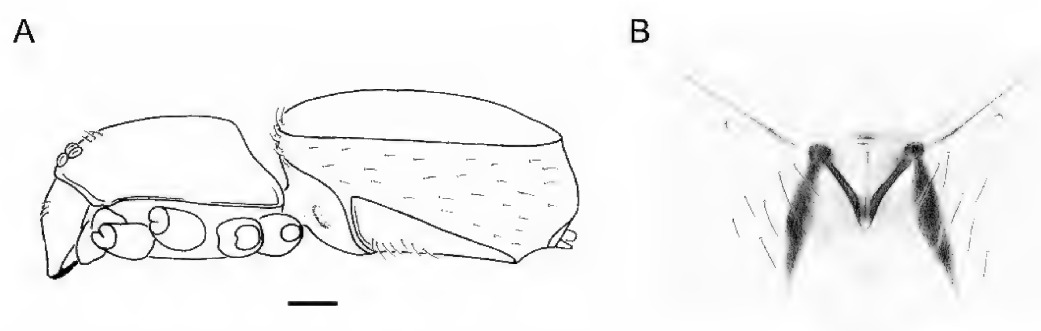


Fig. 60. *Zyngoonops swammerdami*, new species, female. **A.** Habitus, lateral view. **B.** Epigastric region, ventral view. Scale bars: 50 μm (B), 100 μm (A).

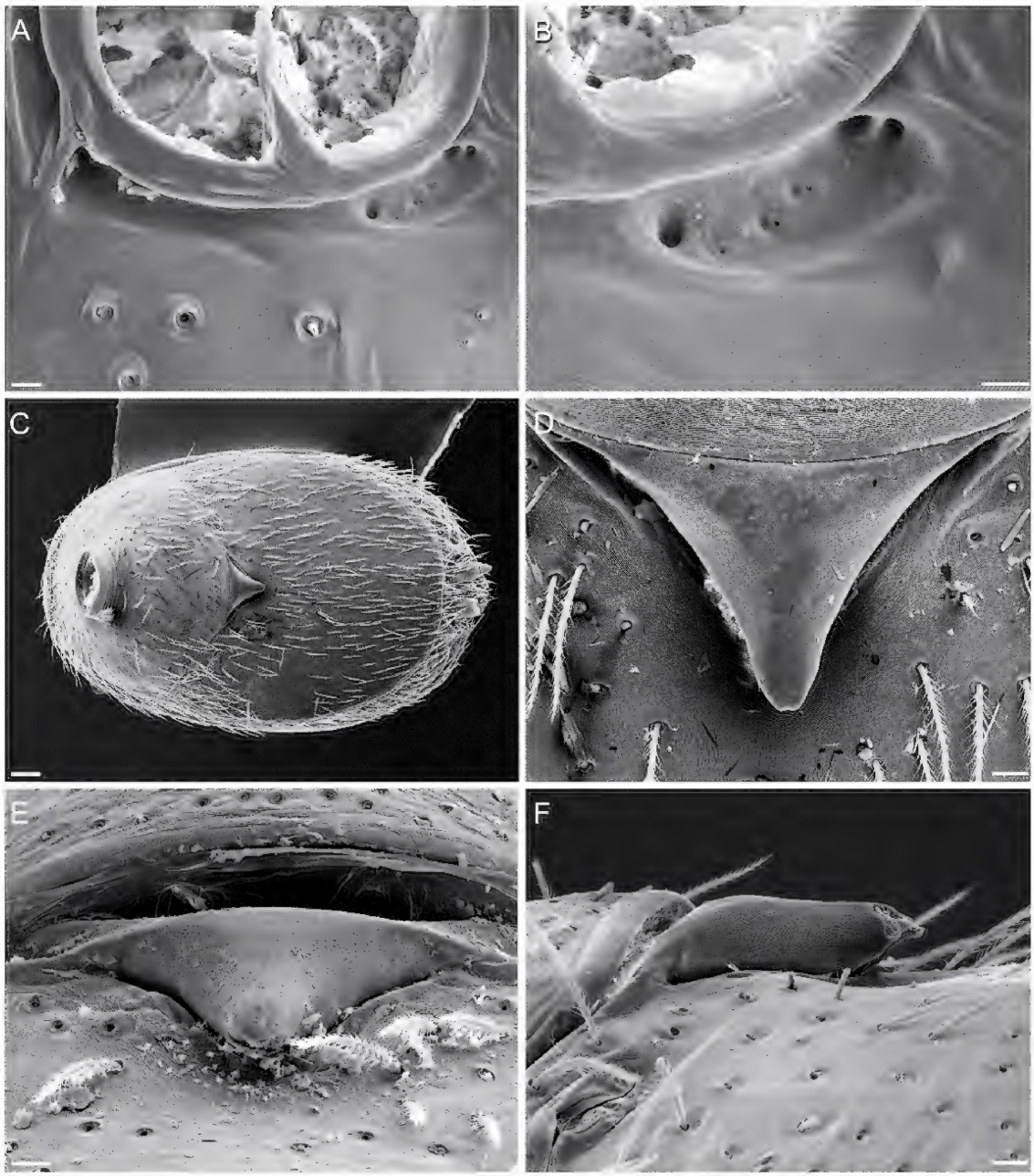


Fig. 61. *Zyngoonops swammerdami*, new species, female. **A.** Infracoxal groove, leg II, ventral view. **B.** Detail of A, showing pores. **C.** Abdomen, ventral view. **D.** Epigastric scape, ventral view. **E.** Same, posterior view. **F.** Same, lateral view. Scale bars: 5 μm (A, B), 10 μm (D–F), 50 μm (C).

The coding of *O. pulcher* is based partly on the literature (Platnick and Dupérré, 2009; Thaler, 1981), partly on SEM study of specimens (kindly provided by Norman Platnick and Nadine Dupérré; specimen codes PBI_OON 36412, 36413; see Platnick and Dupérré, 2009: 17 for specimen data).

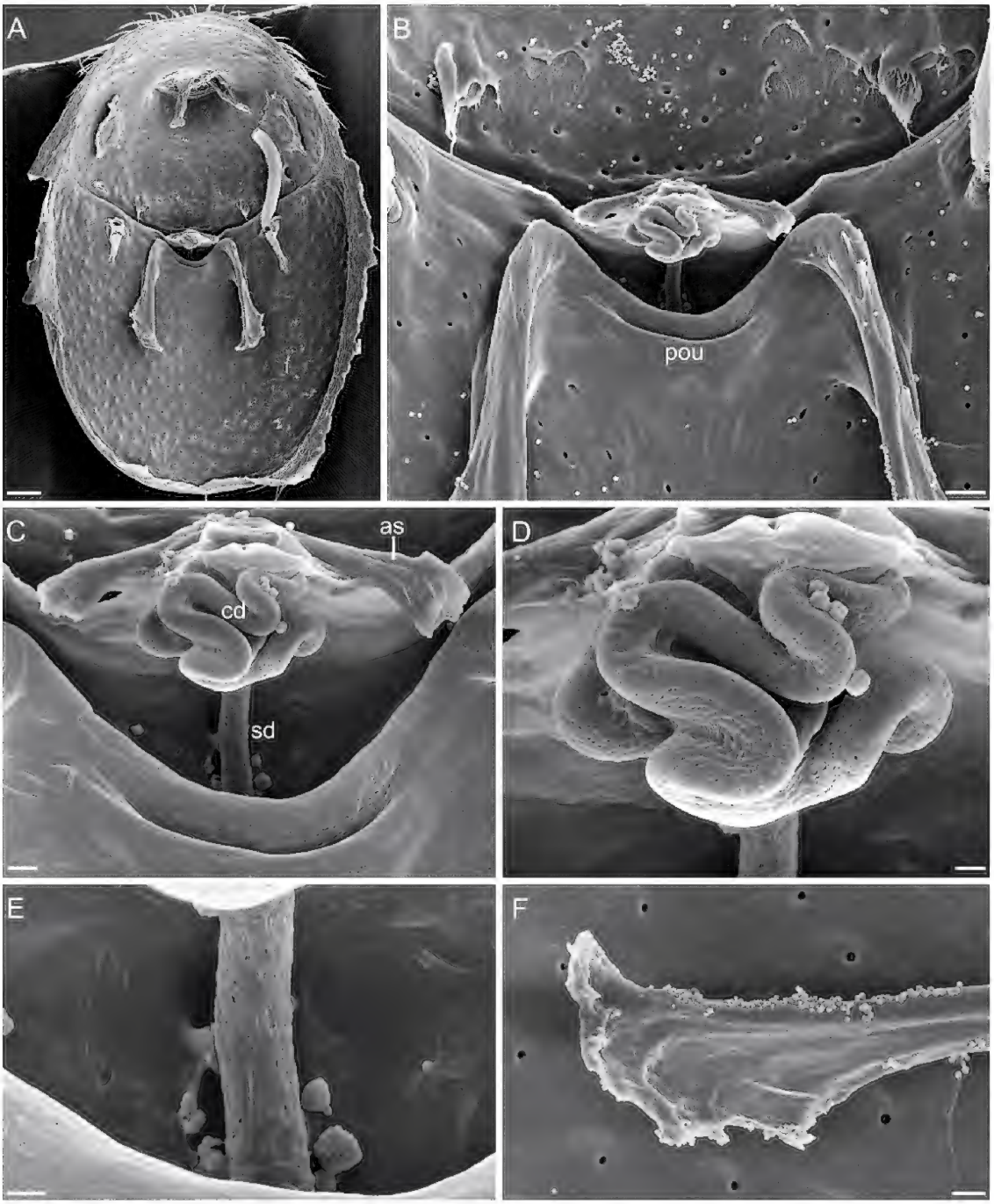


Fig. 62. *Zyngoonops swammerdami*, new species, female. **A.** ES and PES, dorsal view. **B.** Internal genitalia, dorsal view. **C.** Duct and anterior sclerite, dorsal view. **D.** Coiled part of duct, dorsal view. **E.** Straight part of duct, dorsal view. **F.** Lateral apodeme, distal part, dorsal view. Abbreviations: **as,** anterior sclerite; **cd,** coiled part of duct; **pou,** genital pouch; **sd,** straight part of duct. Scale bars: 2.5 μm (D, E), 5 μm (C, F), 10 μm (B), 50 μm (A).

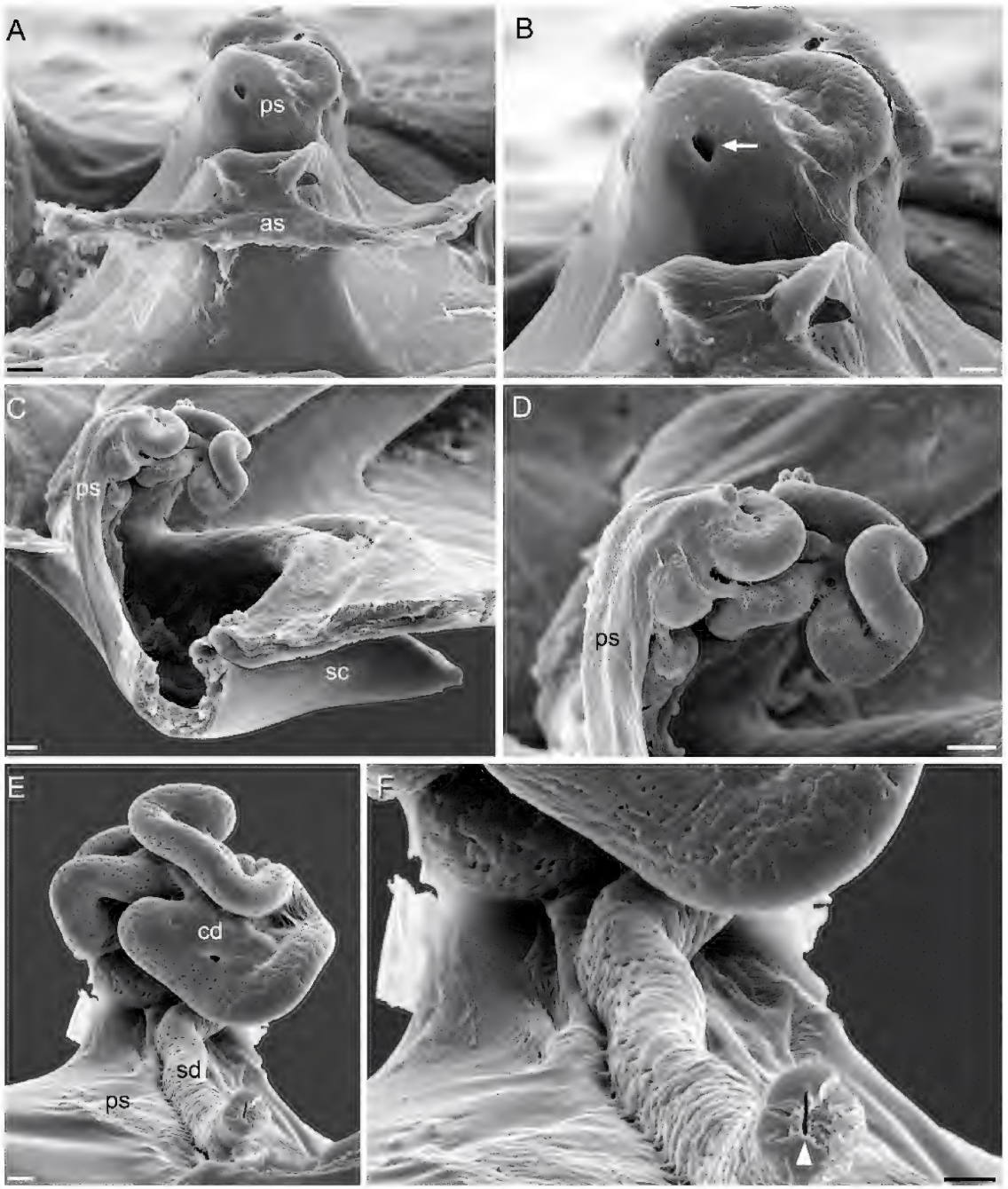


Fig. 63. *Zyngoonops swammerdami*, new species, female. **A.** Anterior and posterior sclerite, anterior view. **B.** Detail of A, showing slitlike opening in posterior sclerite (arrow). **C.** Epigastric scape and internal genitalia, lateral view. **D.** Coiled part of duct, lateral view. **E.** Posterior sclerite, posteroventral view. **F.** Detail of E. Arrowhead: lumen of duct. Abbreviations: **as,** anterior sclerite; **cd,** coiled part of duct; **ps,** posterior sclerite; **sc,** epigastric scape; **sd,** straight part of duct. Scale bars: 2.5 μm (B, E, F), 5 μm (A, C, D).

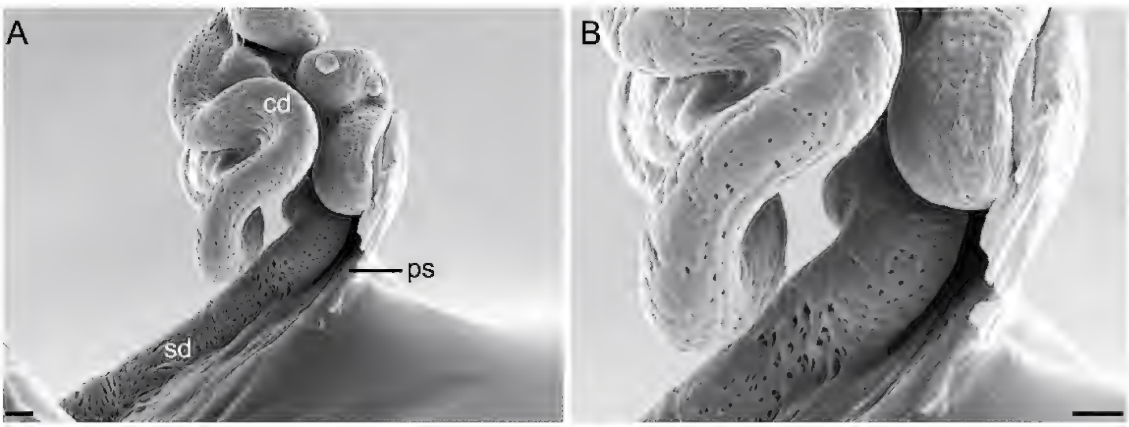


Fig. 64. *Zyngoonops swammerdami*, new species, female. **A.** Posterior sclerite, lateral view. **B.** Detail of A, showing region where duct starts to coil. Abbreviations: **cd,** coiled part of duct; **ps,** posterior sclerite; **sd,** straight part of duct. Scale bars: 2.5 μm.

Character Coding

The data matrix (table 1) includes 41 characters, of which 39 are phylogenetically informative. Reductive character coding was used for nearly all characters (see Strong and Lipscomb, 1999, for rationale). All multistate characters were treated as unordered. Characters and their states are discussed below. Many features show variation that could not be satisfactorily divided into discrete character states. Examples include the relative size of the eyes, the overall carapace shape, the extent and morphology of the microsculpture, the color of the carapace and scuta, and the length of the epigastric scape.

Analyses

The character matrix was compiled using MESQUITE version 2.74 (Maddison and Maddison, 2010). Parsimony analyses were performed in TNT version 1.1 (Goloboff et al., 2008) using an exact algorithm (implicit enumeration) and collapsing branches when the minimum branch length = 0 (Coddington and Scharff, 1990). Bremer support values and jackknife percentages (1000 replications, removal probability = 0.36, cutoff frequency = 50%) were calculated in TNT using equal weights and implicit enumeration.

MESQUITE and WinClada version 1.1 (Nixon, 2002) were used to trace character evolution. Ambiguous character optimizations were usually resolved to favor parallel losses or simplification (see, e.g., chars. 13, 20, 23). Note that this is not equivalent to either the ACCTRAN or DELTRAN optimization (Agnarsson and Miller, 2008; Miller and Hormiga, 2004).

The data matrix and the trees have been deposited in TreeBASE (see www.treebase.org).

Results

Equal weighting resulted in 11 most parsimonious trees (L = 61, CI = 0.80, RI = 0.84; without uninformative characters L = 57, CI = 0.79). All trees support the monophyly of *Zyngoonops*, and all place *Zyngoonops* as the sister group of *Antoonops*. However, the trees disagree on the internal phylogeny of *Zyngoonops*. In the strict consensus, the relationships within the genus are almost fully unresolved.

Implied weighting with the default concavity ($k = 3$) resulted in three trees, a subset of the 11 trees found by equal weighting. The same topologies were obtained when the k-value was varied ($k = 1, 6, 10, 20, 50$). These trees are presented as the preferred hypotheses (figs. 98, 99). The trees differ only in the position of the clade *Z. clandestinus* + *Z. moffetti* (these species show a high proportion of missing entries). The trees place *Z. redii* as sister to all other *Zyngoonops*

TABLE 1

Data matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
Oonops pulcher	0	0	0	0	0	0	0	0	0	0	0	0	0	-	0	-	0	1	1	1	1	1	0	0	0	0	-	-	0	-	0	-	0	0	0	0	0	0	-	-
Melchisedec thevenot	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	0	-	0	-	0	0	0	0	0	0	0	-	-
Antoonops corbulo	0	0	1	0	1	2	1	1	0	0	0	1	1	0	0	1	1	1	2	2	2	2	0	1	1	1	1	0	1	1	0	0	-	0	0	0	1	1	0	1	0
Antoonops nebula	0	1	1	1	0	1	2	1	1	0	0	0	1	1	0	0	1	1	2	2	2	2	0	1	1	1	1	0	1	1	0	0	-	0	0	0	1	1	0	1	0
Coxapopha diblemma	0	1	1	1	1	-	2	1	0	0	1	0	0	0	?	0	2	1	?	?	?	?	1	1	1	1	1	0	0	0	-	0	-	0	0	0	1	0	?	?	?
Zyngoonops clandestinus	?	?	?	?	1	-	1	?	?	?	?	1	0	1	1	?	?	1	1	2	2	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	1	1	1	1
Z. moffetti	?	?	?	?	1	-	1	?	?	?	?	1	0	1	1	?	?	?	1	1	2	2	?	?	?	?	?	?	?	?	?	-	1	1	1	0	1	1	1	1	1
Z. marki	0	0	1	0	0	1	1	1	1	1	0	1	0	1	0	2	1	1	1	2	2	2	1	0	0	1	1	0	0	0	-	1	1	1	0	1	1	1	1	1	2
Z. swammerdami	0	0	1	0	0	0	1	1	1	1	0	1	0	1	0	2	1	1	1	2	2	2	1	0	0	1	1	0	0	-	1	1	1	1	0	1	1	1	1	1	2
Z. redii	0	1	1	1	0	0	1	1	1	1	0	1	0	1	0	2	1	1	1	2	2	2	1	0	0	1	1	1	0	-	1	1	0	-	0	1	1	1	1	0	2
Z. chambersi	1	1	1	1	0	0	1	1	1	1	0	1	0	1	0	2	1	1	1	2	2	2	1	0	1	1	1	1	0	0	-	1	1	1	1	1	1	1	1	1	2
Z. beatriceae	1	1	1	1	0	0	1	1	1	1	0	1	0	1	0	2	1	1	1	2	2	2	1	0	1	1	1	1	0	0	-	1	1	1	1	1	1	1	1	1	2
Z. goedaerti	0	1	1	1	0	1	1	1	1	1	0	1	0	1	0	2	1	1	?	?	?	?	1	0	0	1	1	1	0	1	1	1	0	0	?	1	1	1	1	?	?
Z. rockoxi	0	1	1	1	0	0	1	1	1	1	0	1	0	1	0	1	0	2	1	?	?	?	1	0	1	1	1	2	0	?	?	1	0	0	?	1	1	1	1	?	?

species (figs. 98, 99). One of the trees was arbitrarily selected for character tracing (fig. 98).

Characters

Prosoma and legs

1. Male, carapace, posterodorsal part, shape: 0, not reclining; 1, reclining. Figure 100 illustrates the states of this character. *Z. chambersi* and *Z. beatriceae* are the only species with a reclining male carapace.

2. Male, carapace, stripes: 0, absent; 1, present. Males of the *Zyngoonops* group usually have stripes on the carapace (figs. 37C–E, 104A–D), but three species appear to lack them, viz., *A. corbulo* (which has a fovea but no stripes), *Z. marki* and *Z. swammerdami*. Usually, there are nine stripes (a dorsal, two lateral and six intermediate stripes; see, e.g., *Z. beatriceae*, fig. 37C–E); however, *C. diblemma* and *A. nebula* may have fewer stripes. *C. diblemma* has lateral stripes, but no dorsal or intermediate stripes could be seen. In *A. nebula*, only three stripes were observed (a short dorsal stripe flanked by two intermediate stripes). Presence of stripes is here a synapomorphy of the *Zyngoonops* group.

The scoring of this character is problematic in a number of ways. First, the visibility of the stripes depends on the color of the carapace. In species with a very dark carapace, the stripes may be more difficult to see. Second, the state of preservation of the specimens may also influence the visibility of the stripes. Given these difficulties, the analysis was repeated with character 2 deleted. This resulted in three trees; they differ from the original trees only in that the clade *Z. marki* + *Z. swammerdami* is collapsed.

3. Male, carapace, anterolateral corners: 0, without extension; 1, with extension. In males of the *Zyngoonops* group, each anterolateral corner forms a prominent, roughly triangular extension (figs. 24A, 32B). In lateral view, the extension is situated immediately posterior to the palpal insertion (fig. 24A).

4. Posterior eye row: 0, present; 1, absent. *C. diblemma*, *Z. clandestinus,* and *Z. moffetti* have only two eyes (figs. 3B, 10B, 78B). The

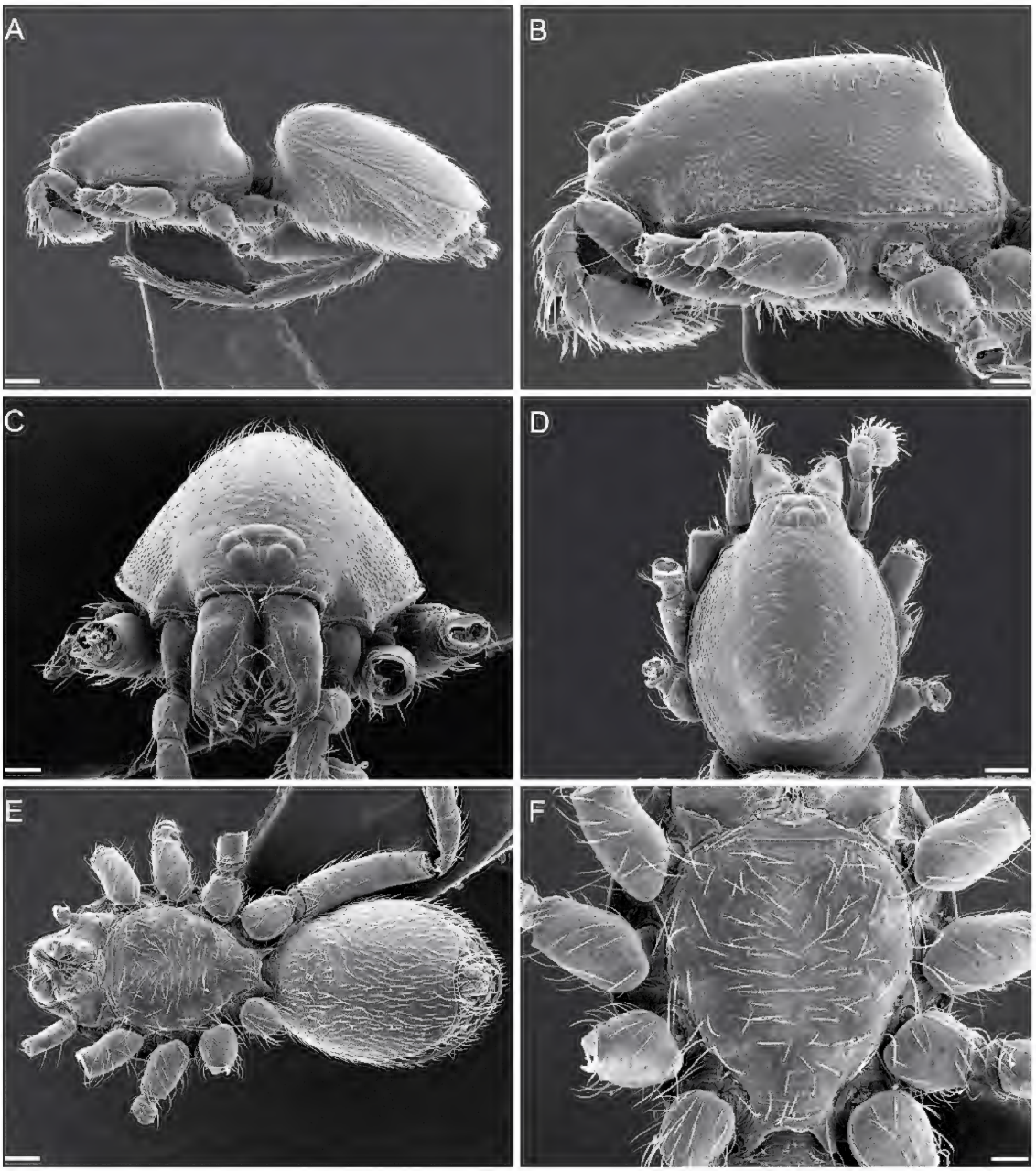


Fig. 65. *Zyngoonops marki*, new species, male. **A.** Habitus, lateral view. **B.** Carapace, lateral view. **C.** Same, anterior view. **D.** Same, dorsal view. **E.** Habitus, ventral view. **F.** Sternum, ventral view. Scale bars: 50 μm (B, C, F), 100 μm (A, D, E).

shape and relative position of the eyes suggest they are ALEs; hence, the posterior eye row is considered lost. The loss of the posterior eye row provides unambiguous support for the clade *Z. clandestinus* + *Z. moffetti*.

5. PME, relative position: 0, touching or almost touching; 1, clearly separated. Well-separated PMEs are a synapomorphy of *Antoonops*.

6. Paturon, posterior surface, long setae, number: 0, two; 1, three; 2, five. Many

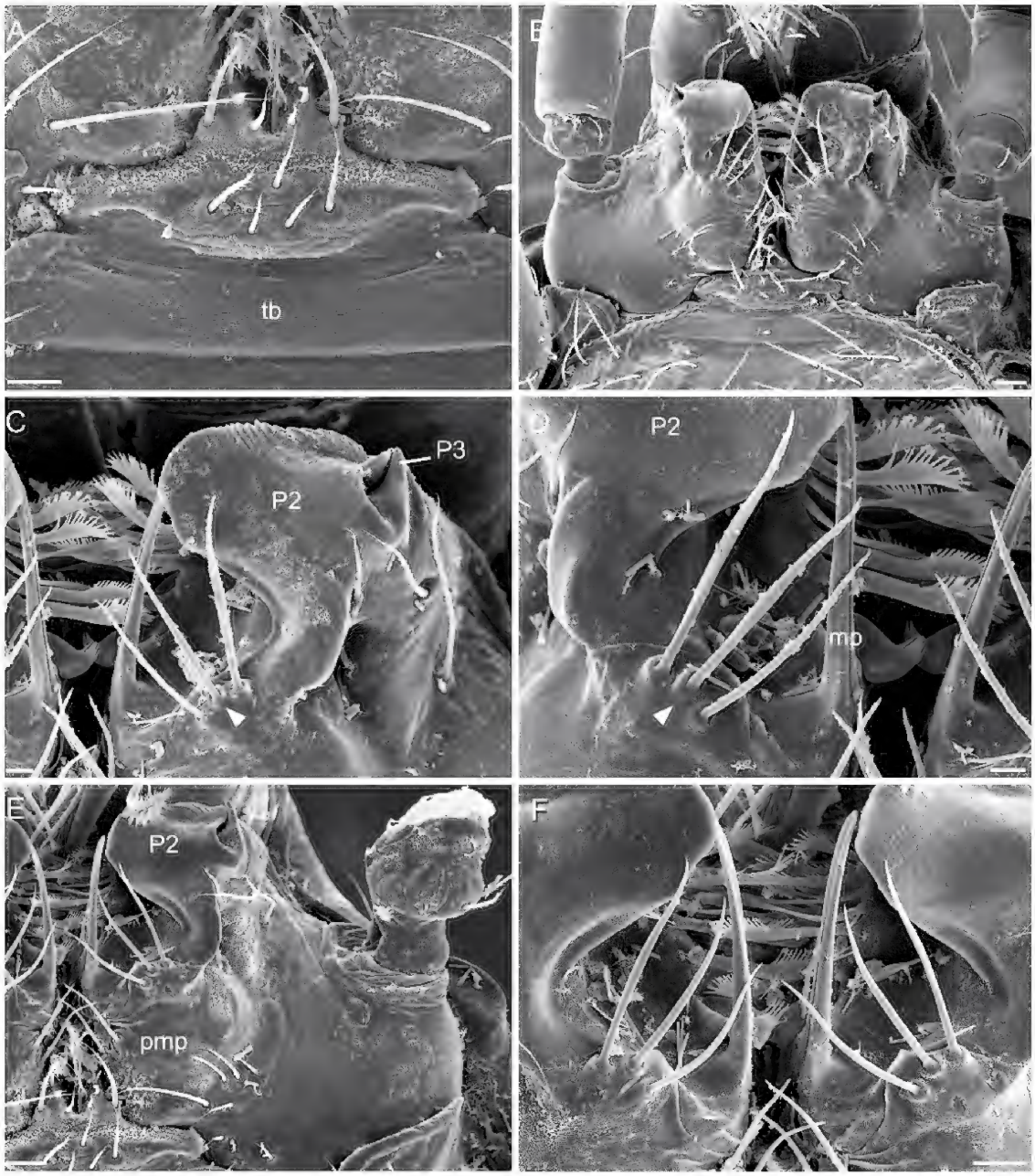


Fig. 66. *Zyngoonops marki*, new species, male. **A.** Labium, ventral view. **B.** Mouthparts, ventral view. **C.** Left endite, P2 and P3, ventral view. Arrowhead: setae 1–3. **D.** Right endite, median projection and setae 1–3 (arrowhead), ventral view. **E.** Other specimen, left endite, ventral view. **F.** Median projections and setae 1–3, ventral view. Abbreviations: **mp,** median projection; **P,** projection; **pmp,** posteromedian part of endite; **tb,** transverse band. Scale bars: 5 μm (C, D), 10 μm (A, F), 20 μm (B, E).

oonopids have a row of long, hirsute setae on the posterior surface of the paturon (fig. 11B; Fannes and Jocqué, 2008: fig. 30). Judging from the available images, most oonopid genera have two setae per row, e.g., *Oonops* Templeton and *Heteroonops* Dalmas (Platnick and Dupérré, 2009: figs. 11, 107, 276, 315); *Brignolia* Dumitrescu and Georgescu

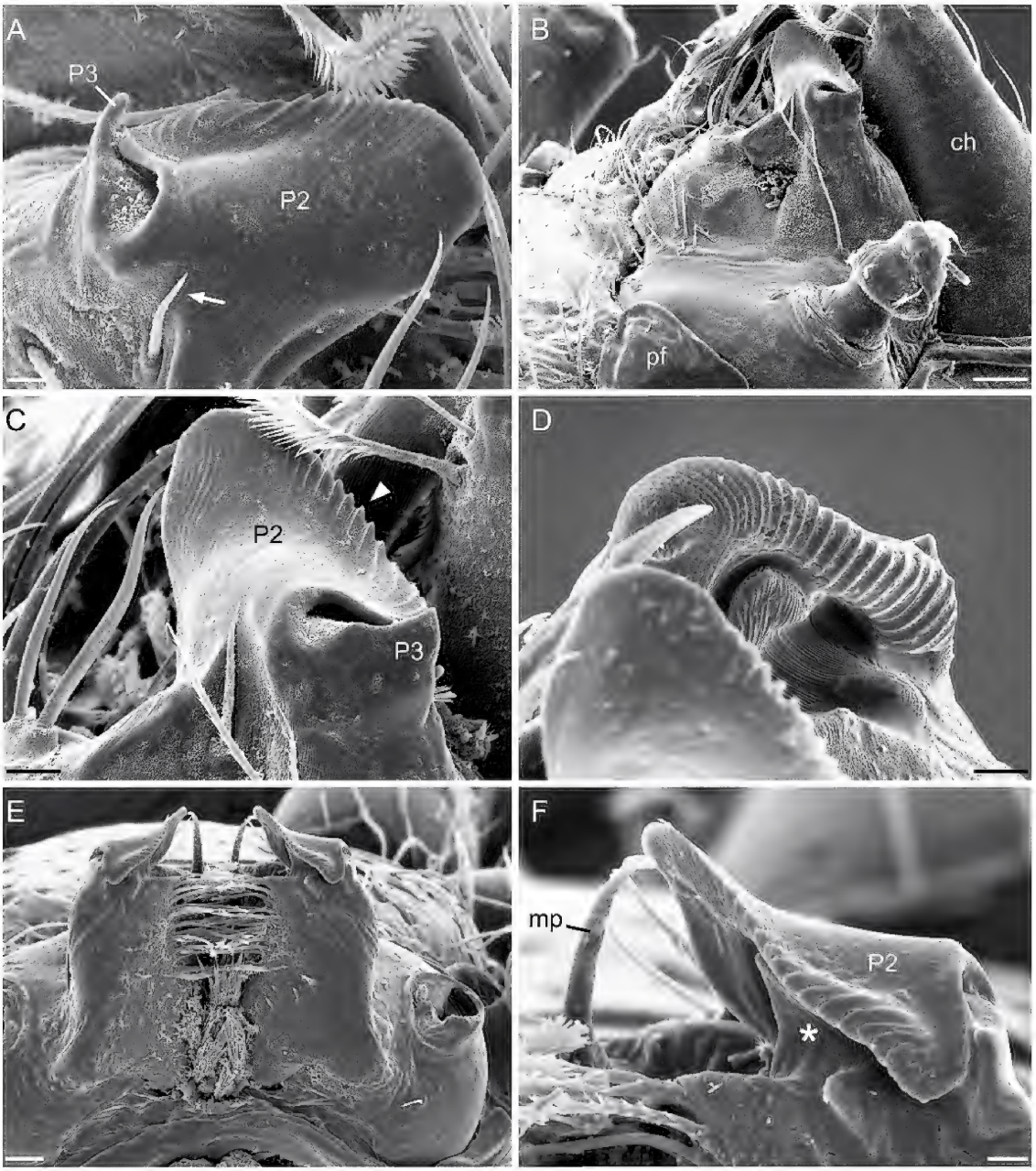


Fig. 67. *Zyngoonops marki*, new species, male. **A.** Right endite, P2 and P3, ventral view. Arrow: seta 4. **B.** Endites, lateral view. **C.** Left endite, P2 and P3, lateral view. Arrowhead: serrated edge of P2. **D.** Right endite, P2, median view. **E.** Endites, anterior view. **F.** Right endite, median projection, P2 and P4 (asterisk), anterior view. Abbreviations: **ch,** chelicera; **mp,** median projection; **P,** projection; **pf,** pleural flap. Scale bars: 10 μm (A, C, D, F), 30 μm (B, E).

(Platnick et al., 2011: figs. 26, 58); *Niarchos* and *Scaphios* Platnick and Dupérré (2010c: figs. 48, 82, 495, 527, 579, 619, 729, 767); *Pescennina* Simon (Platnick and Dupérré, 2011b: figs. 105, 145); *Scaphiella* Simon (Platnick and Dupérré, 2010a: fig. 154); *Melchisedec* Fannes (2010b: fig. 15). In the present analysis, a row of five setae is a

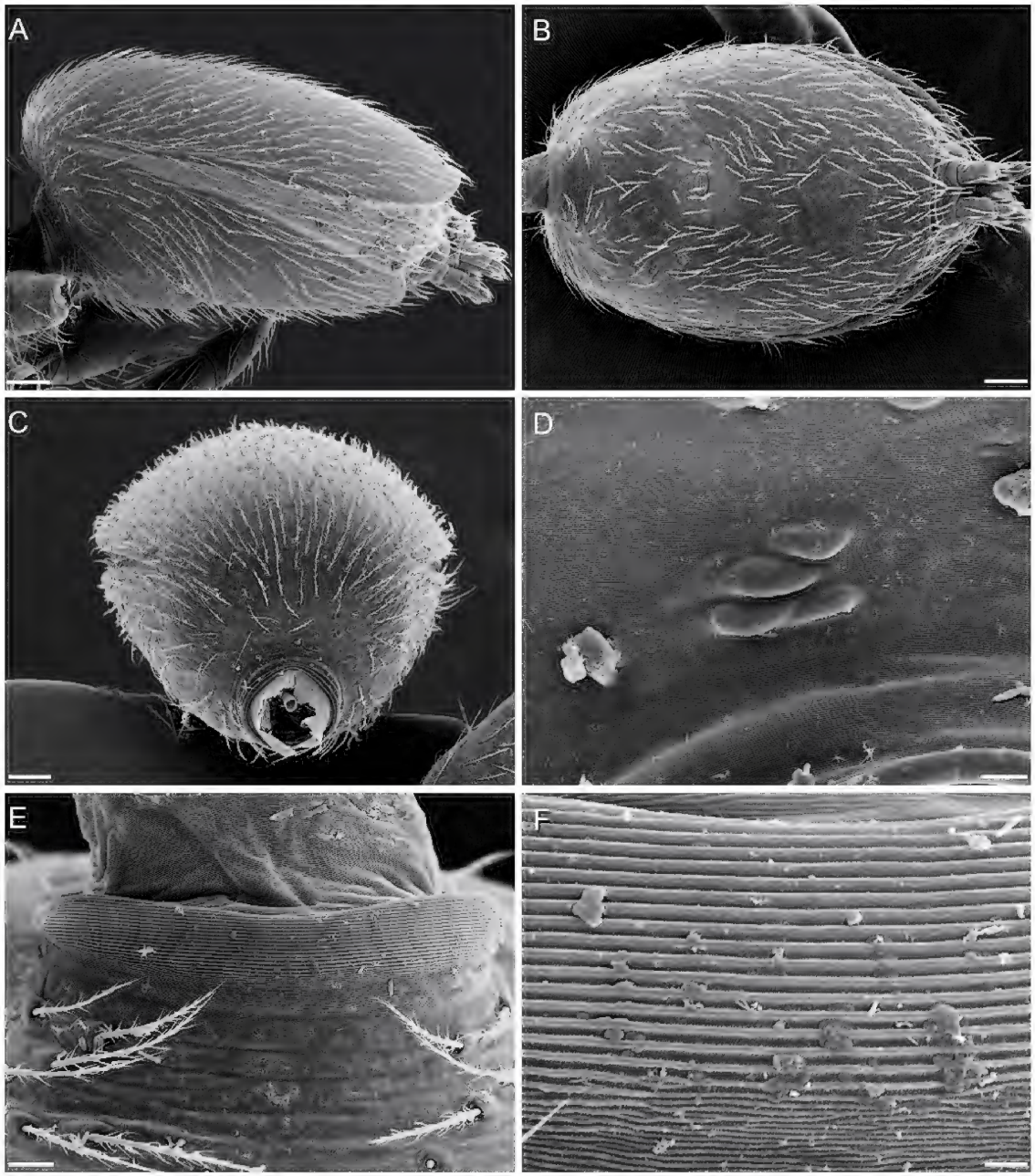


Fig. 68. *Zyngoonops marki*, new species, male. **A.** Abdomen, lateral view. **B.** Same, ventral view. **C.** Same, anterior view. **D.** Tubercles above pedicel tube, anterior view. **E.** Pedicel tube, ventral view. **F.** Detail of E, showing ridges of ventral lip. Scale bars: 2 μm (F), 5 μm (D), 10 μm (E), 50 μm (A–C).

synapomorphy of the *Zyngoonops* group, with subsequent reduction to three setae in *Zyngoonops*. Interestingly, at least some members of the *Dysderina* complex also show the unusual number of five setae (see, e.g., Platnick and Dupérré, 2011a: figs. 20, 48, 141, 177).

7. Male, pleural flaps: 0, absent; 1, present. In males of the *Zyngoonops* group, the pleural membrane forms a pair of flaplike

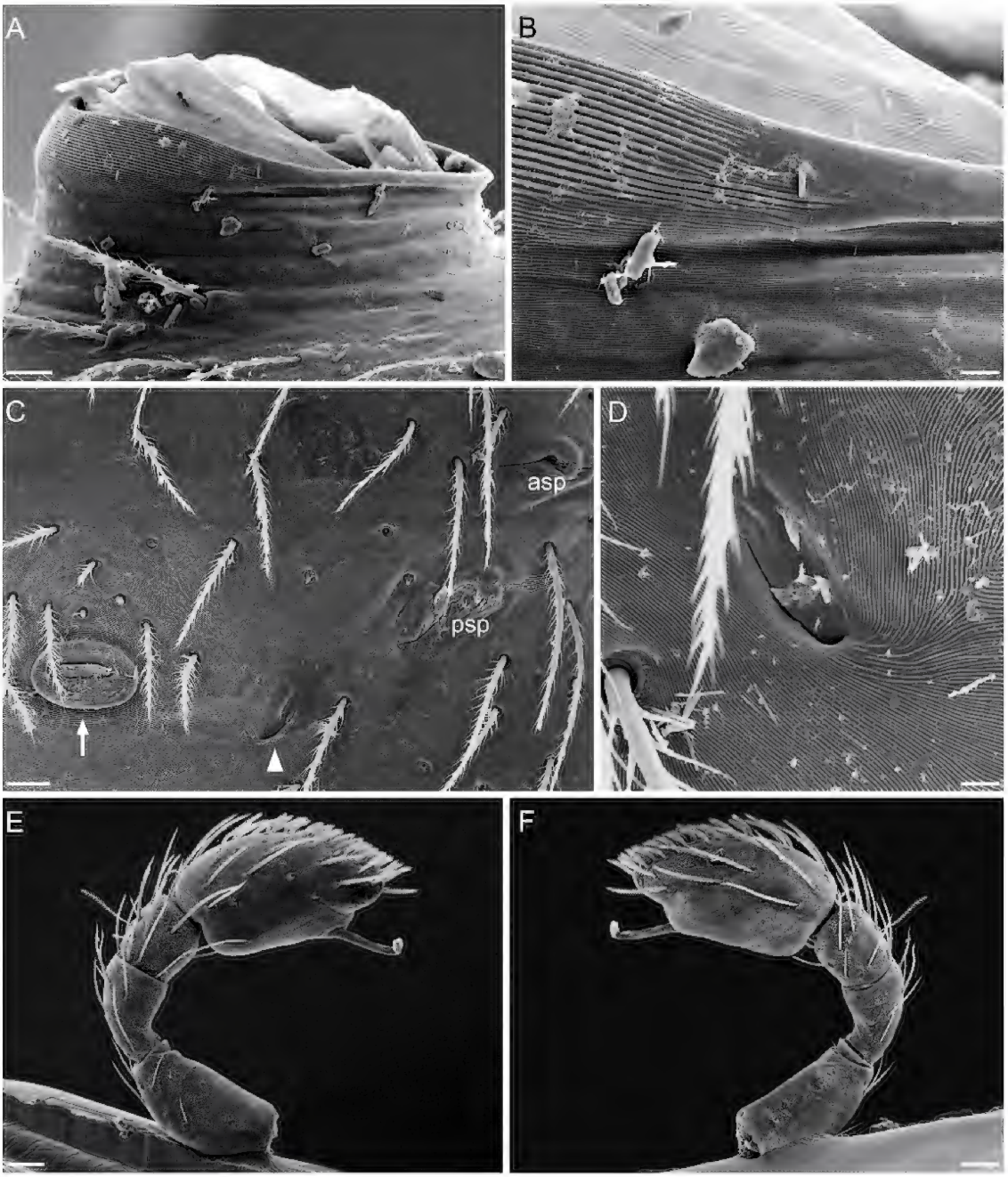


Fig. 69. *Zyngoonops marki*, new species, male. **A.** Pedicel tube, lateral view. **B.** Detail of A, showing region where ventral lip begins. **C.** Epigastric region, ventral view, showing sperm pore (arrow), additional orifice (arrowhead), anterior spiracle (asp) and posterior spiracle (psp). **D.** Additional orifice, ventral view. **E.** Pedipalp, prolateral view. **F.** Same, retrolateral view. Scale bars: 3 μm (B, D), 10 μm (A, C), 30 μm (E, F).

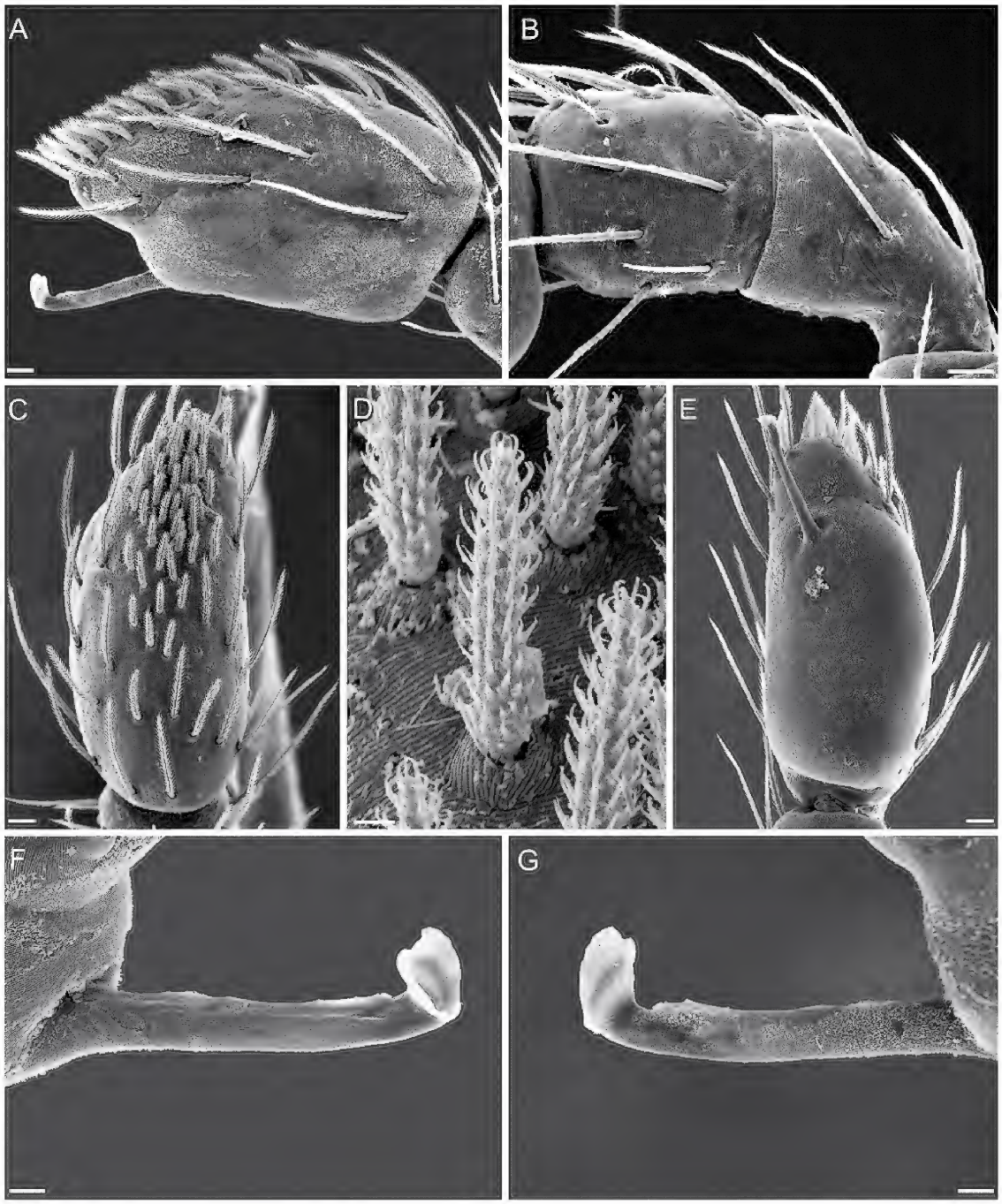


Fig. 70. *Zyngoonops marki*, new species, male. **A.** Bulb, retrolateral view. **B.** Palpal tibia and patella, retrolateral view. **C.** Cymbium, dorsal view. **D.** Cymbium, setae, dorsal view. **E.** Bulb, ventral view. **F.** Embolus, prolateral view. **G.** Same, retrolateral view. Scale bars: 2 μm (D), 5 μm (F, G), 10 μm (A–C, E).

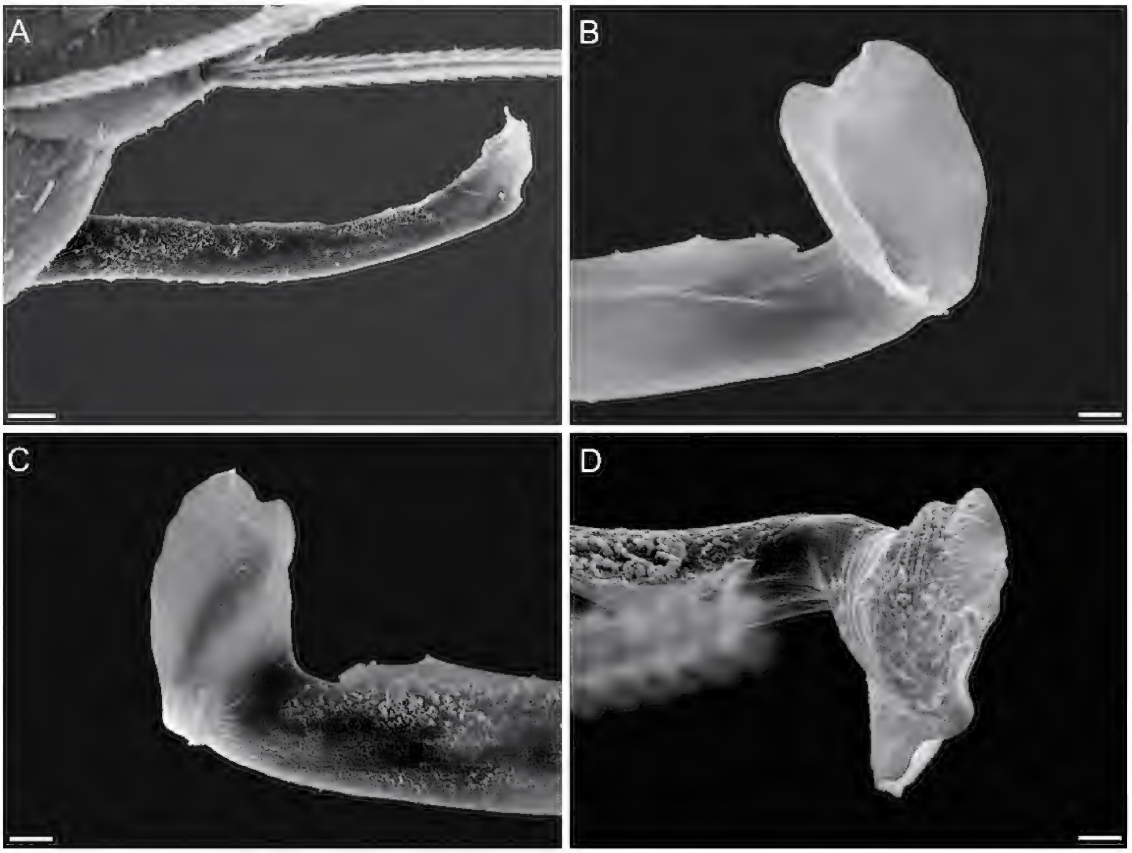


Fig. 71. *Zyngoonops marki*, new species, male. **A.** Other specimen, embolus, retrolateral view. **B.** Tip of embolus, prolateral view. **C.** Same, retrolateral view. **D.** Same, dorsal view. Scale bars: 2 μm (B–D), 5 μm (A).

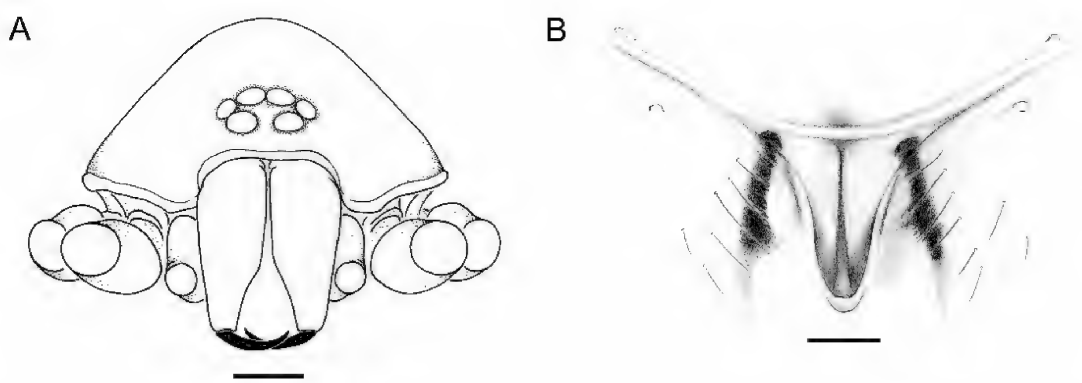


Fig. 72. *Zyngoonops marki*, new species, female. **A.** Carapace, anterior view. **B.** Epigastric region, ventral view. Scale bars: 50 μm (B), 100 μm (A).

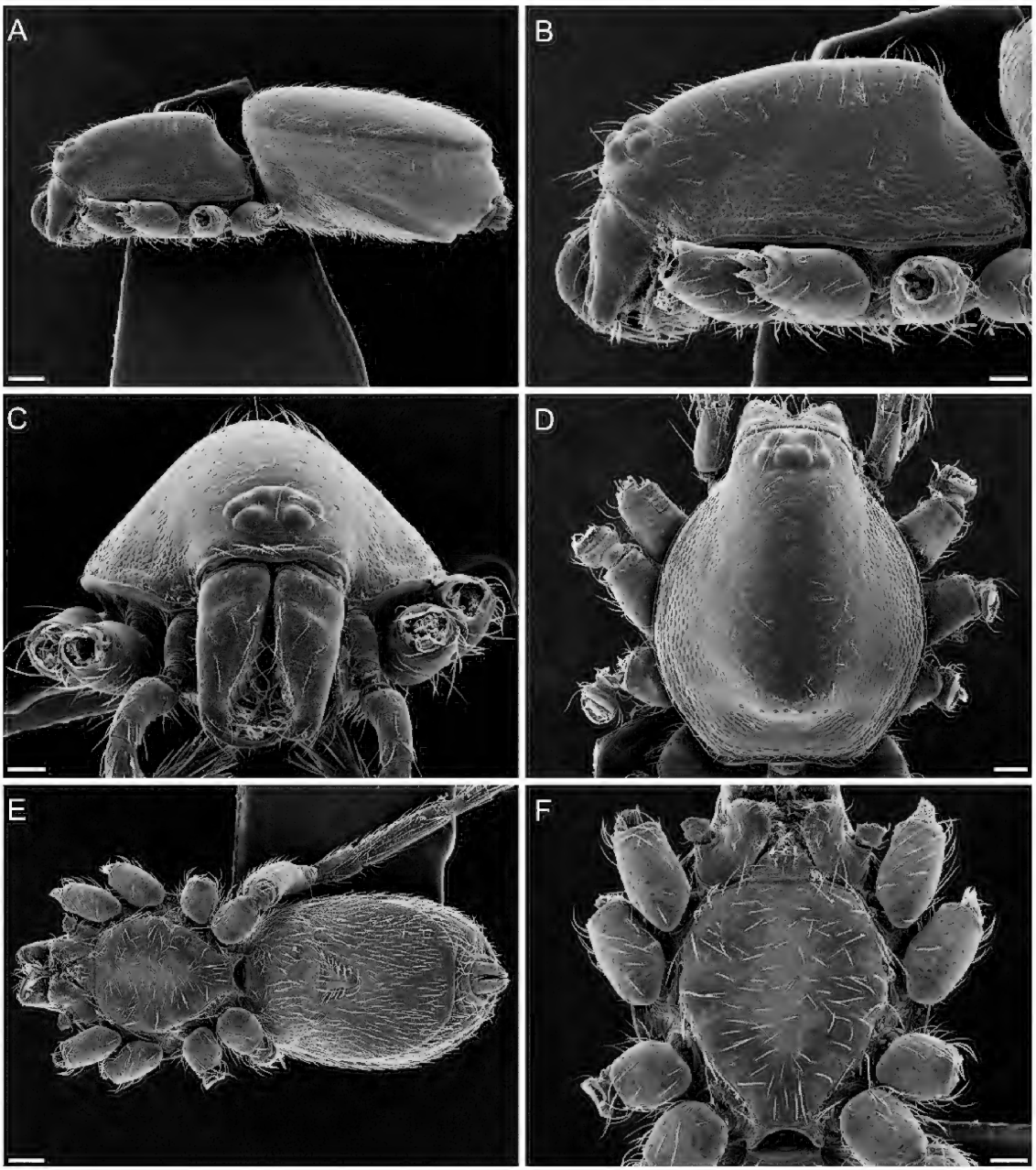


Fig. 73. *Zyngoonops marki*, new species, female. **A.** Habitus, lateral view. **B.** Carapace, lateral view. **C.** Same, anterior view. **D.** Same, dorsal view. **E.** Habitus, ventral view. **F.** Sternum, ventral view. Scale bars: 50 μm (B–D, F), 100 μm (A, E).

expansions. These flaps partly cover the endites (figs. 19A, D, 80E, 92A). The pleural flaps are much more heavily sclerotized than the rest of the pleura (fig. 104F). There is variation in the size of the flaps, with *Coxapopha* having the smallest and *Zyngoonops* having the largest (see, e.g., figs. 32C, 79C). Unfortunately, the variation in size could not be satisfactorily divided into discrete character states.

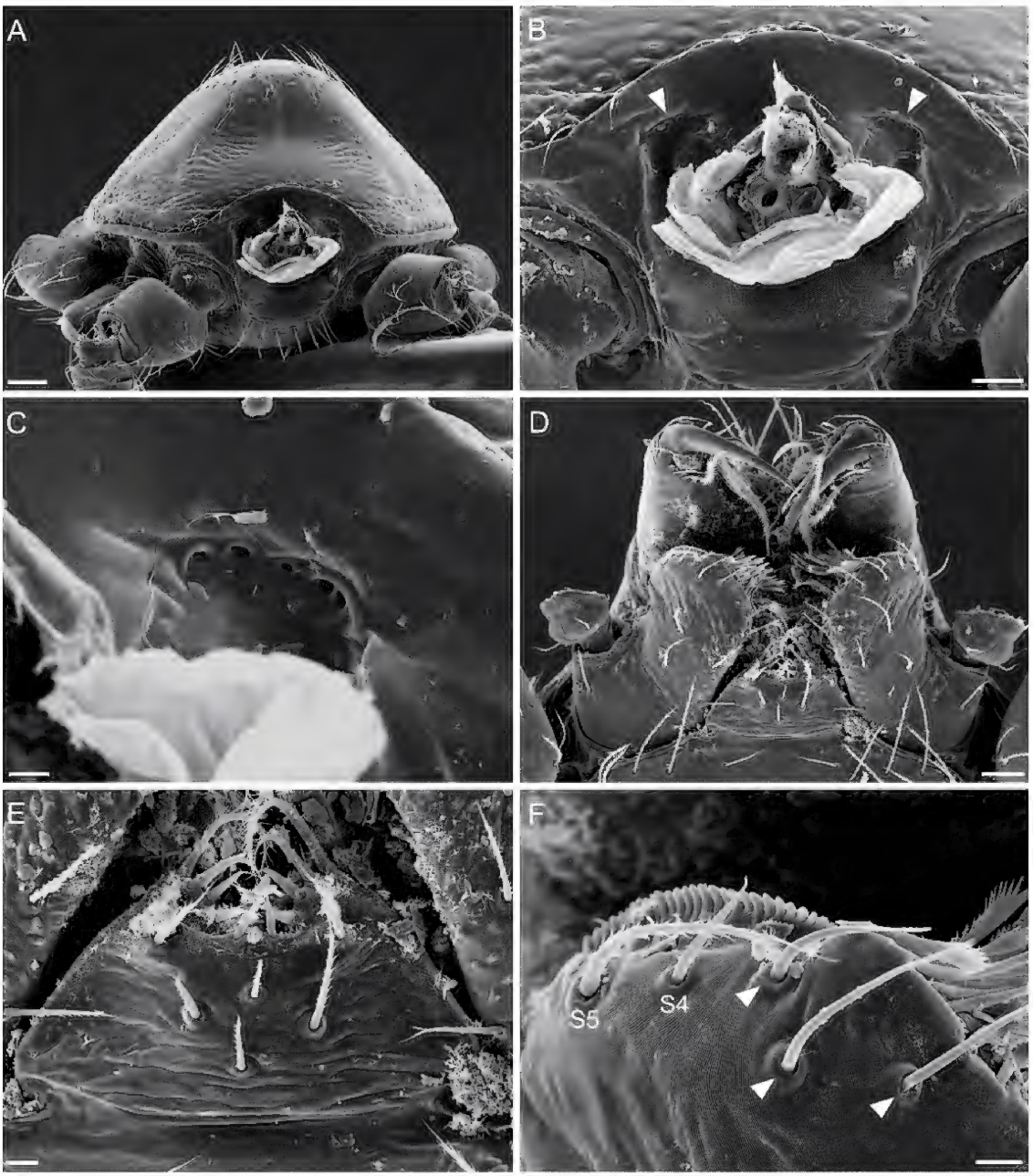


Fig. 74. *Zyngoonops marki*, new species, female. **A.** Carapace, posterior view. **B.** Same, detail. Arrowheads: rows of small openings. **C.** Detail of row of small openings. **D.** Mouthparts, ventral view. **E.** Labium, ventral view. **F.** Detail of right endite, showing setae 1–3 (arrowheads) and setae 4–5 (s4–5). Scale bars: 5 μm (C, E, F), 25 μm (B, D), 50 μm (A).

8. Male, sternum, anterior margin: 0, not protruding; 1, protruding. In males of *Antoonops* and *Zyngoonops*, the anterior margin of the sternum is protruded, forming two oblique ridges (figs. 25A, 91C). In females of these genera, the sternum also appears protruded. *M. thevenot* is coded as having state 0 because the sternum is, at best,

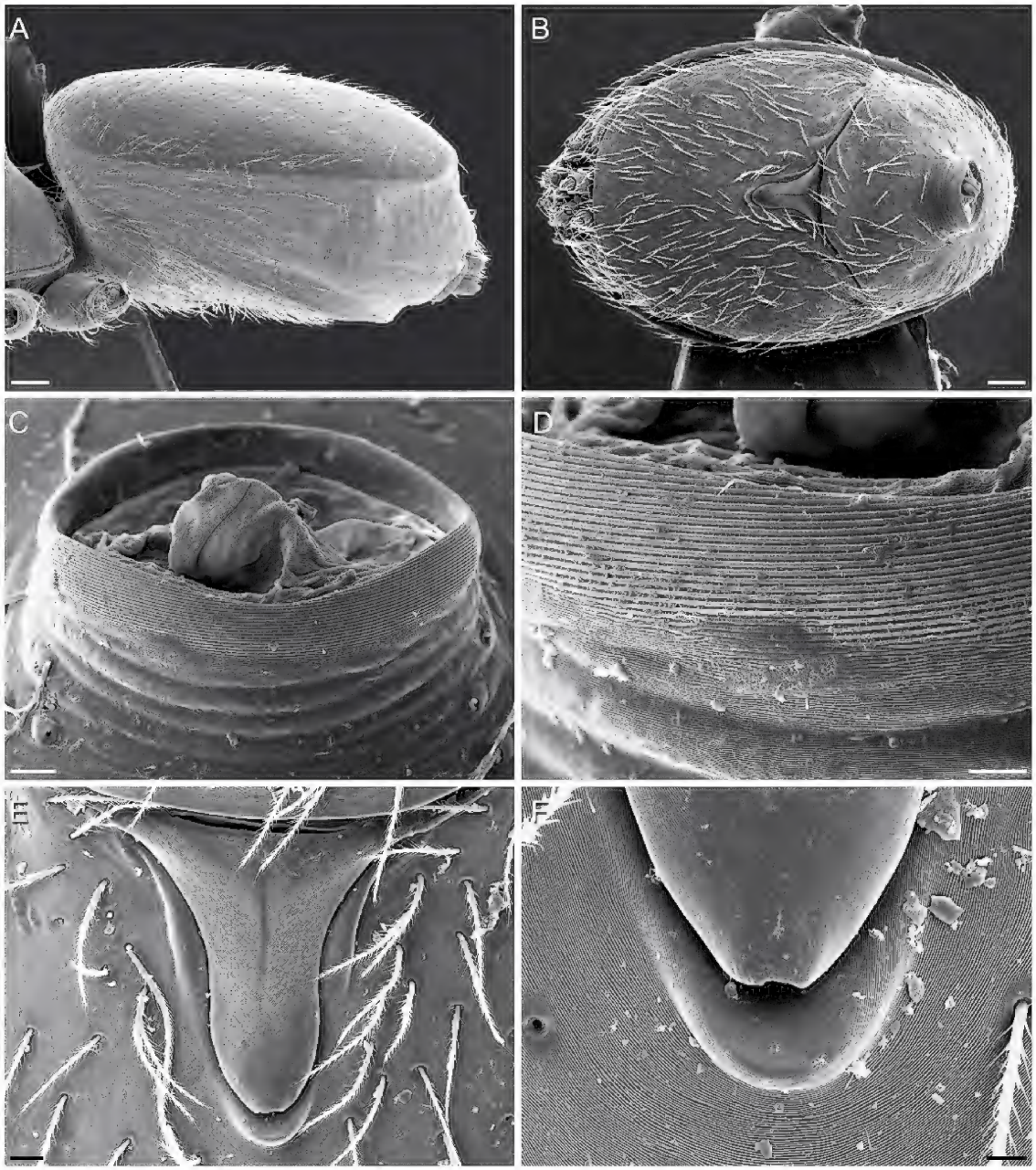


Fig. 75. *Zyngoonops marki*, new species, female. **A.** Abdomen, lateral view. **B.** Same, ventral view. **C.** Pedicel tube, ventral view. **D.** Detail of C, showing ridges of ventral lip. **E.** Epigastric scape, ventral view. **F.** Tip of epigastric scape, ventral view. Scale bars: 4 μm (D, F), 10 μm (C, E), 50 μm (A, B).

only slightly protruded (fig. 95C). When *M. thevenot* is coded as having state 1, there is no difference to the resulting topologies.

9. Male, sternum, anterior transverse band: 0, absent; 1, present. In males of *Zyngoonops*, the anteriormost part of the sternum shows a transverse band (figs. 18F, 32C, 38C, D, 66A). The band is slightly elevated (e.g., fig. 32C) and has a distinct posterior margin (arrowheads in figs. 32C, 38D). In many

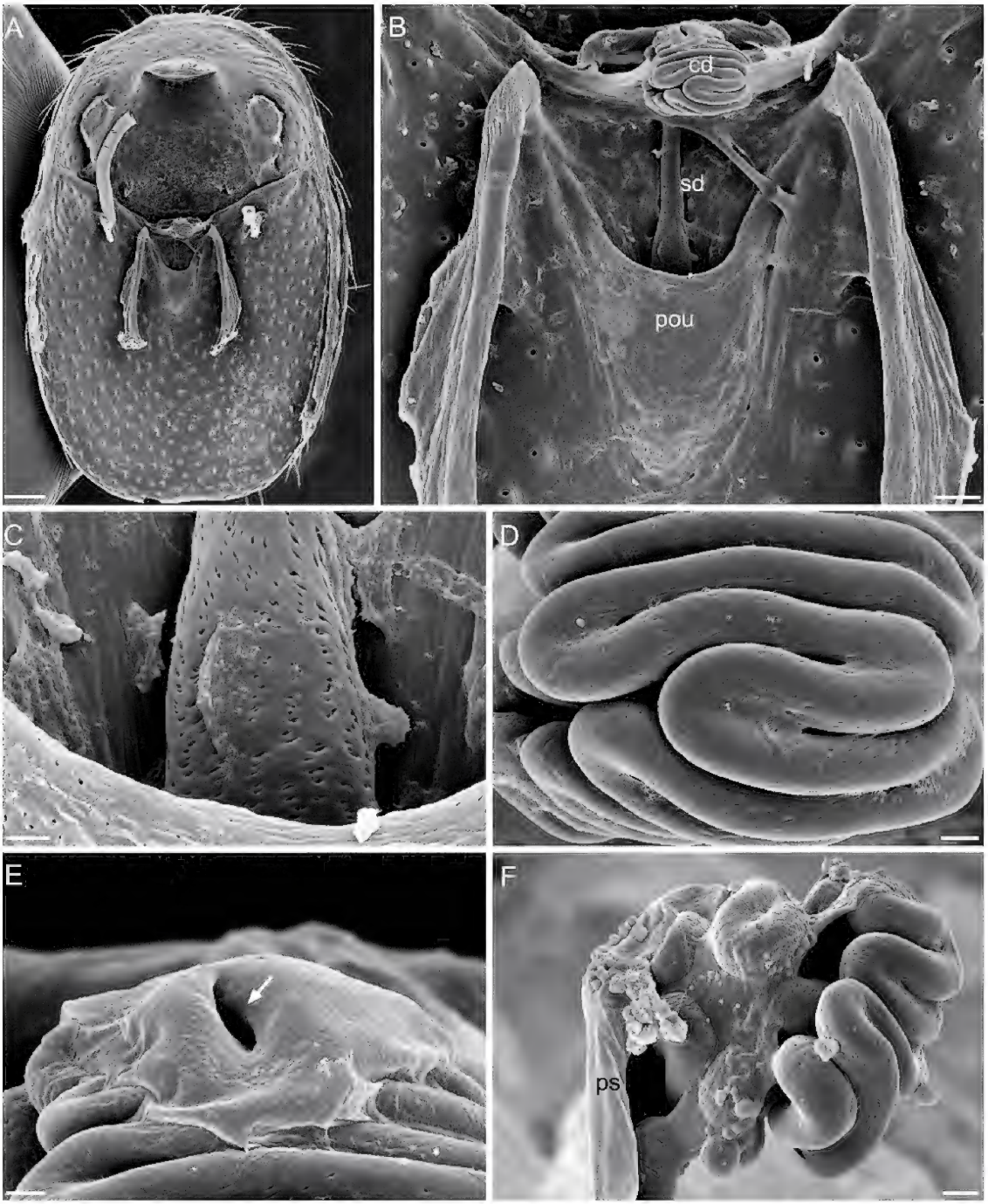


Fig. 76. *Zyngoonops marki*, new species, female. **A.** ES and PES, dorsal view. **B.** Internal genitalia, dorsal view. **C.** Straight part of duct, dorsal view. **D.** Coiled part of duct, dorsal view. **E.** Posterior sclerite, dorsal view. Arrow: slitlike opening. **F.** Coiled part of duct, lateral view. Abbreviations: **cd,** coiled part of duct; **pou,** genital pouch; **ps,** posterior sclerite; **sd,** straight part of duct. Scale bars: 2 μm (C–F), 10 μm (B), 50 μm (A).

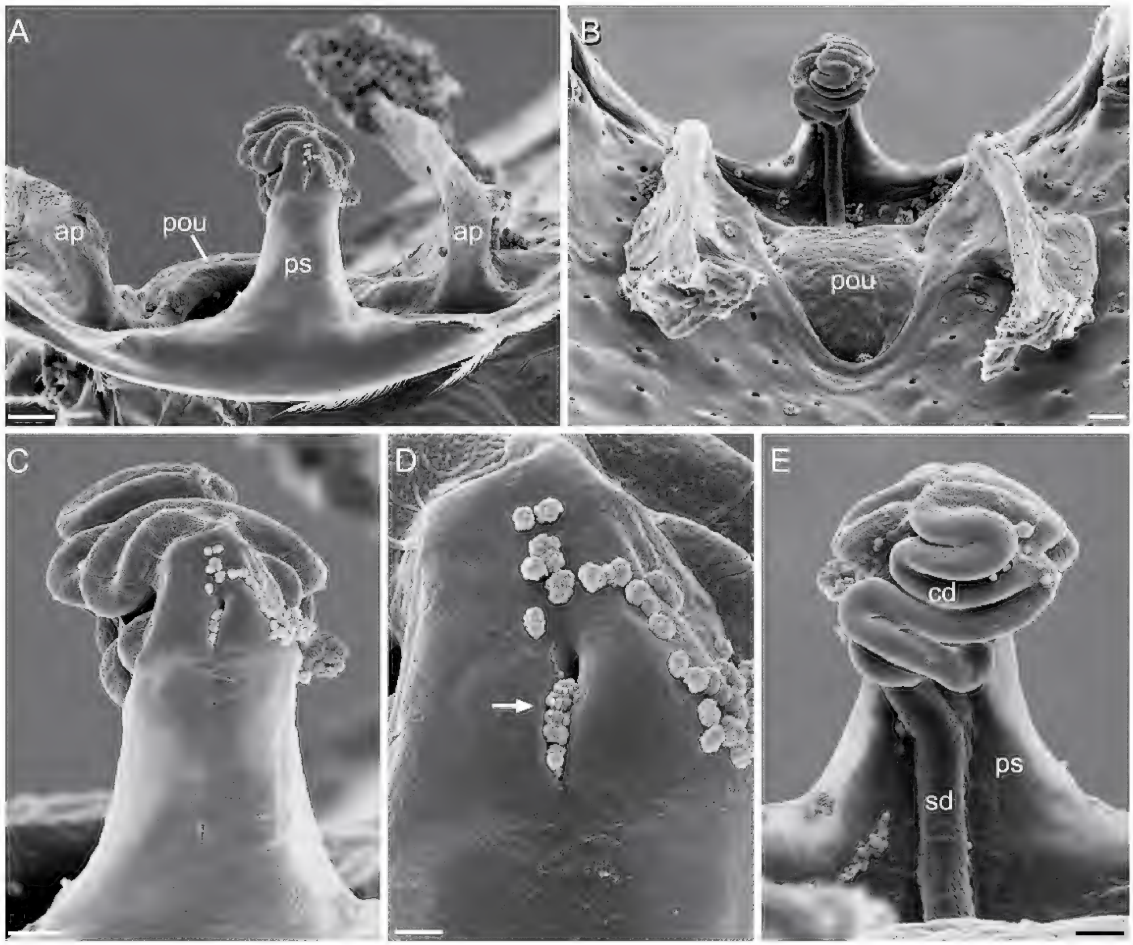


Fig. 77. *Zyngoonops marki*, new species, female. **A.** Internal genitalia, anterior view. **B.** Same, posterior view. **C.** Posterior sclerite, anterior view. **D.** Detail of C, showing slitlike opening (arrow). **E.** Posterior sclerite, posterior view. Abbreviations: **ap,** lateral apodeme; **cd,** coiled part of duct; **pou,** genital pouch; **ps,** posterior sclerite; **sd,** straight part of duct. Scale bars: 2 μm (D), 5 μm (C, E), 10 μm (A, B).

species, there appears to be a large internal structure below the transverse band (the structure is clearly visible through the body wall; see fig. 104F). In *Antoonops* males, the protruding part of the sternum does not show a distinct band (figs. 90B, 91C). Deleting this character does not alter the topologies of the MPTs.

10. Male, sternum, length/width: 0, longer than wide; 1, wider than long. Sternum length was measured along the midline, from the labium to the posterior tip; sternum width was measured at the widest point. *M. thevenot* and *C. diblemma* have a ratio length/width of 0.95 or less; the other species have a ratio of 1.06 or more. Characters 8 and 10 may not be completely independent. The analysis was therefore repeated with character 8 deleted; the same topologies were recovered.

11. Sternum, prongs: 0, absent; 1, present. Sternal prongs (e.g., figs. 3C–F, 33F) are a synapomorphy of *Zyngoonops*. As discussed above, the prongs presumably interact with the ventral lip (figs. 5D–F, 35A) to form a stridulatory organ. Given that the prongs and lip are very likely functionally correlated, the presence of a lip is not coded as a separate character.

12. Sternum, posteriormost part: 0, not demarcated by ridge; 1, demarcated by ridge. In *Antoonops*, the posterior tip is demarcated

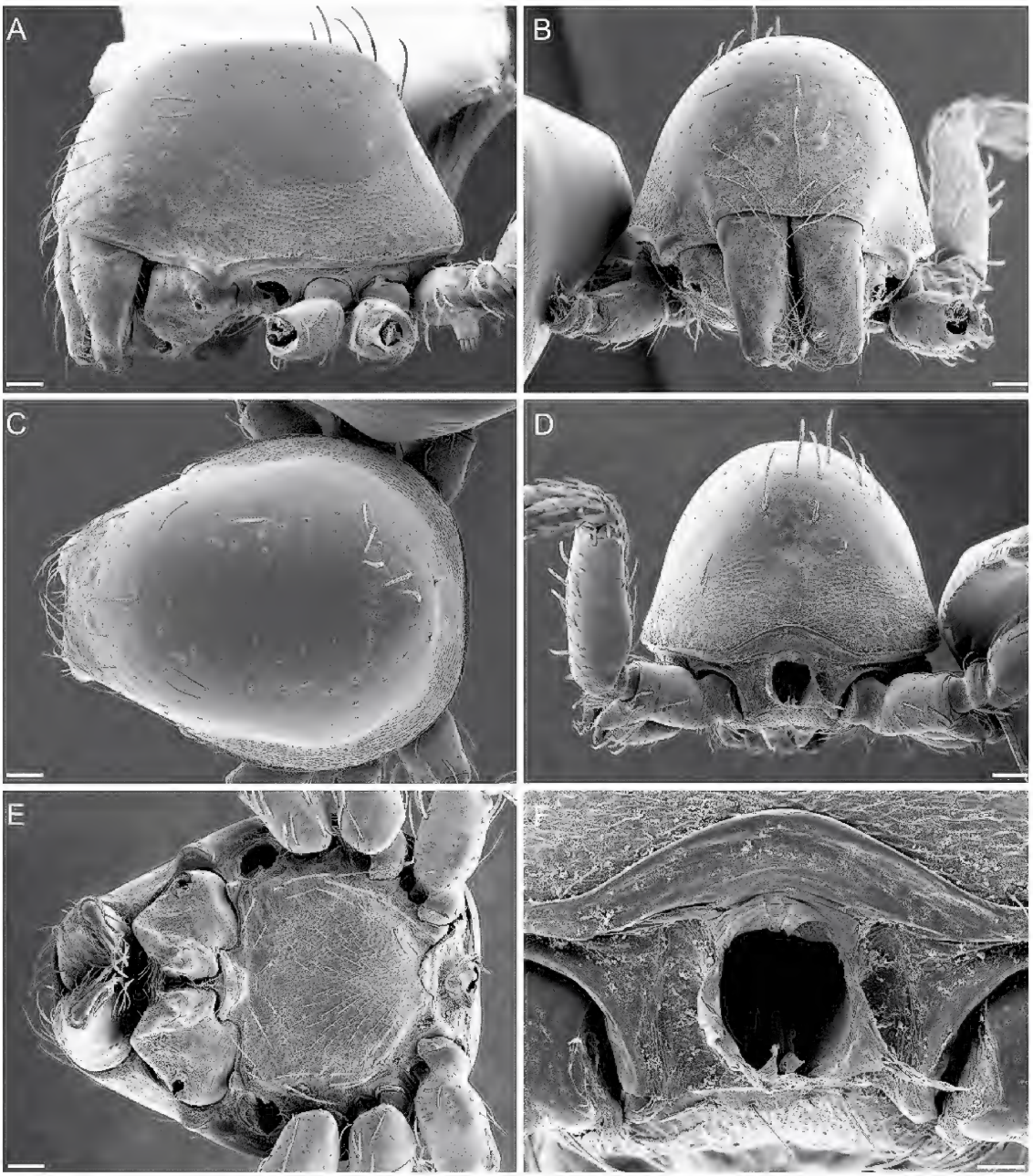


Fig. 78. *Coxapopha diblemma* Platnick, male, carapace. **A.** Lateral view. **B.** Anterior view. **C.** Dorsal view. **D.** Posterior view. **E.** Ventral view. **F.** Region between coxae IV, posterior view. Scale bars: 50 μm (F), 100 μm (A–E).

from the rest of the sternum by a sclerotized ridge (or ridges; fig. 90C). Deleting this character does not alter the topologies of the MPTs.

13. Tibiae and metatarsi I, spination: 0, with ventral pairs of spines; 1, without spines. *O. pulcher* and *C. diblemma* have ventral pairs of spines on the tibiae and metatarsi I. The overall spination pattern is quite different in the two species (e.g., *O. pulcher* has spines on all legs, *C. diblemma* only on leg I).

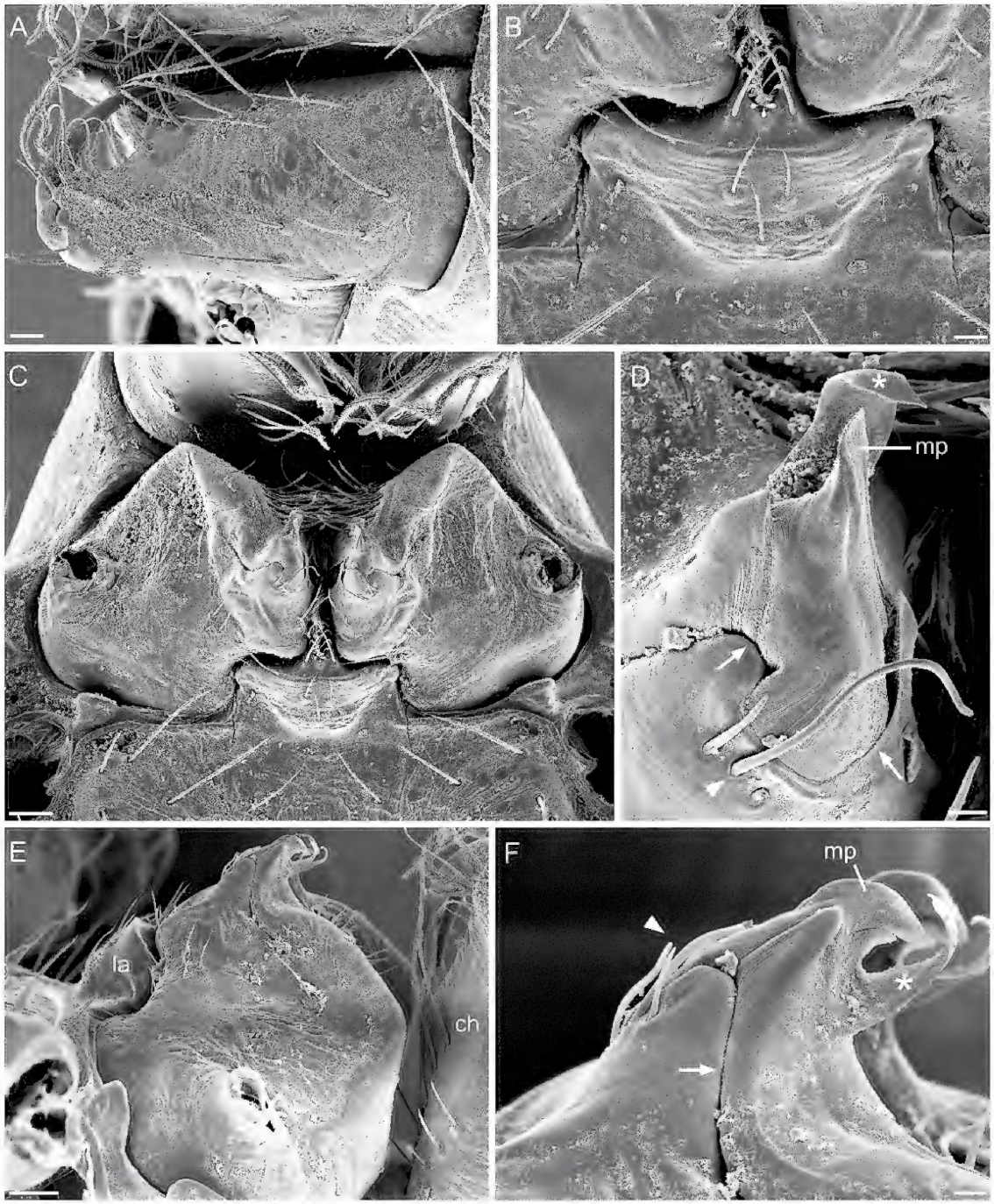


Fig. 79. *Coxapopha diblemma* Platnick, male. **A.** Chelicerae, anterior view. **B.** Labium, ventral view. **C.** Mouthparts, ventral view. **D.** Right endite, median projection, ventral view. Asterisk: anterior extension. Arrows: groove. Arrowhead: setae 1–3. **E.** Endites, lateral view. **F.** Left endite, median projection, lateral view. Asterisk: anterior extension. Arrowhead: setae 1–3. Arrow: groove. Abbreviations: **ch,** chelicera; **la,** labium; **mp,** median projection. Scale bars: 5 μm (D, F), 10 μm (B), 30 μm (A, C, E).

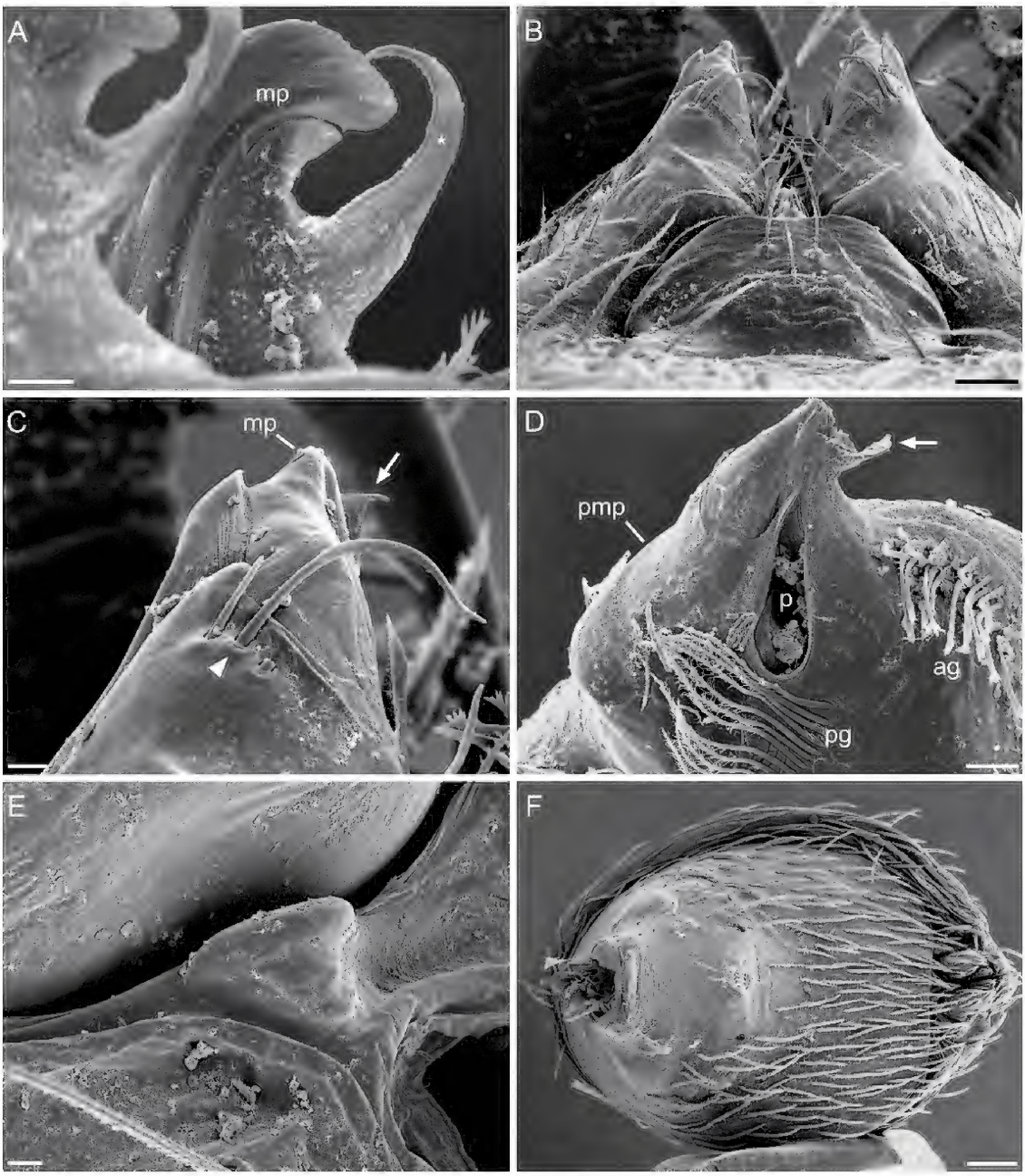


Fig. 80. *Coxapopha diblemma* Platnick, male. **A.** Right endite, median projection, median view. Asterisk: anterior extension. **B.** Labium and median part of endites, posterior view. **C.** Right endite, median projection and setae 1–3 (arrowhead), posterior view. Arrow: anterior extension. **D.** Right endite, median view (tip of median projection broken off). Arrow: anterior extension. **E.** Pleural flap, ventral view. **F.** Abdomen, ventral view. Abbreviations: **ag,** anterior group of setae; **mp,** median projection; **p,** pocket; **pg,** posterior group of setae; **pmp,** posteromedian part of endite. Scale bars: 5 μm (A, C, E), 20 μm (B, D), 100 μm (F).

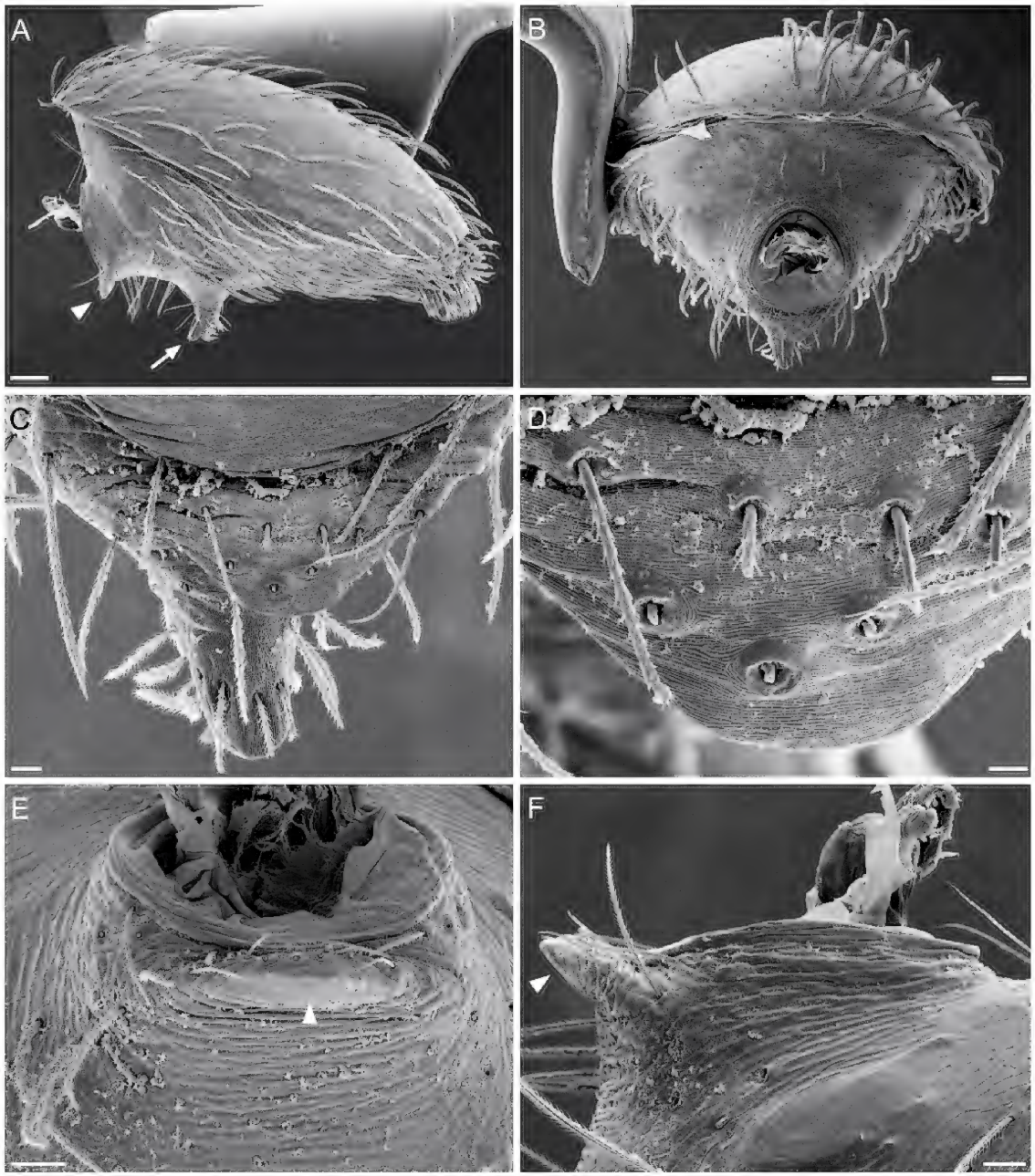


Fig. 81. *Coxapopha diblemma* Platnick, male. **A.** Abdomen, lateral view. Arrowhead: anterior apophysis. Arrow: posterior apophysis. **B.** Same, anterior view. **C.** Detail of B, showing anterior and posterior apophysis. **D.** Anterior apophysis, anterior view. **E.** Pedicel tube, ventral view. Arrowhead: anterior apophysis. **F.** Same, lateral view. Arrowhead: anterior apophysis. Scale bars: 5 μm (D), 10 μm (C), 30 μm (E, F), 50 μm (A, B).

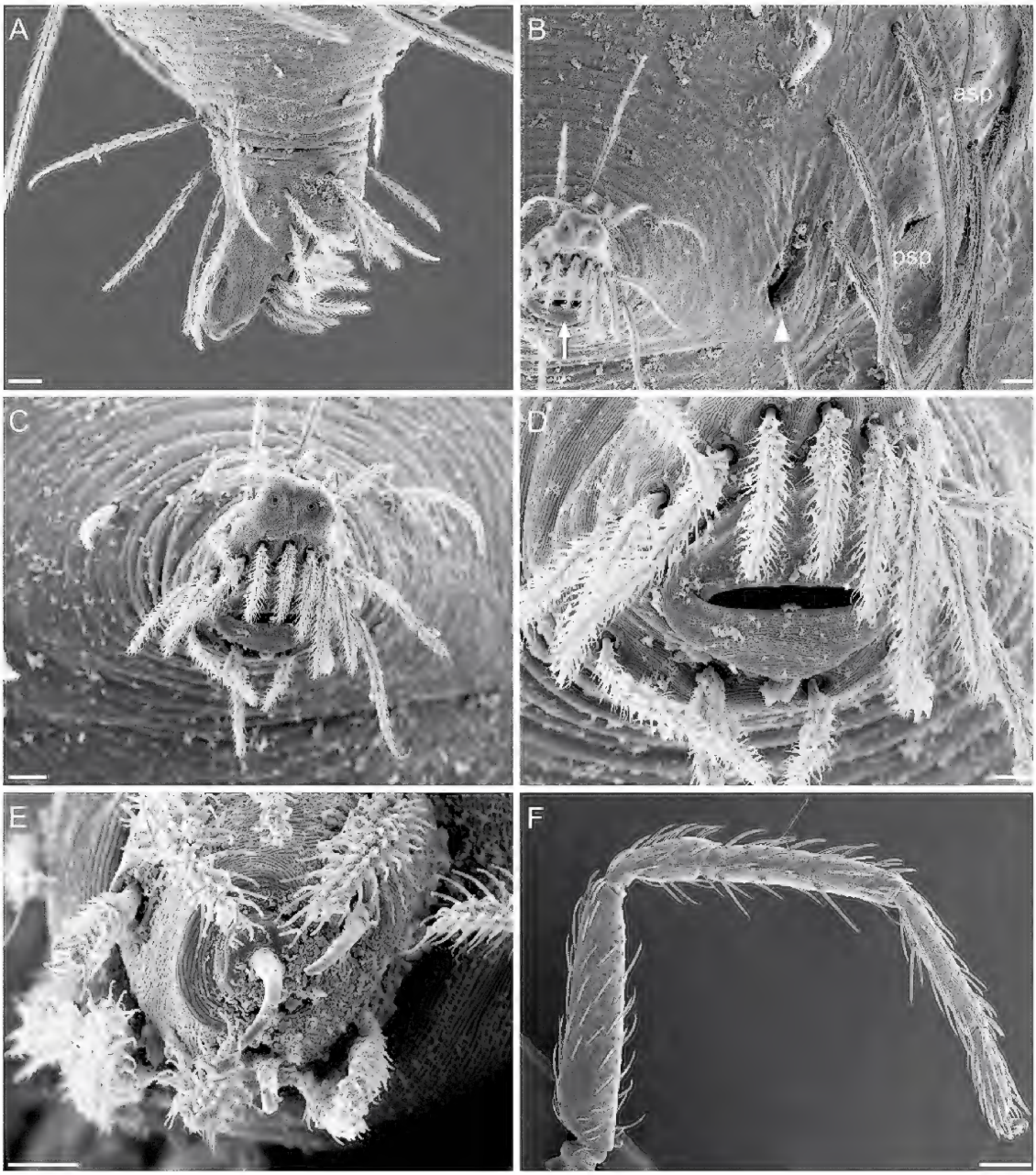


Fig. 82. *Coxapopha diblemma* Platnick, male. **A.** Posterior apophysis, lateral view. **B.** Epigastric region, ventral view, showing sperm pore (arrow), additional orifice (arrowhead), anterior spiracle (asp) and posterior spiracle (psp). **C.** Posterior apophysis, ventral view. **D.** Sperm pore, ventral view. **E.** ALS, posterior view. **F.** Leg I, retrolateral view. Scale bars: 5 μm (D, E), 10 μm (A–C), 100 μm (F).

The individual spines have not been coded as separate characters to avoid problems with character independence. This character has been optimized to preserve the homology of the spines.

Abdomen

14. Female, DS, length: 0, covering more than ¾ of abdomen length; 1, covering about ¼ of abdomen length. State 1 is an

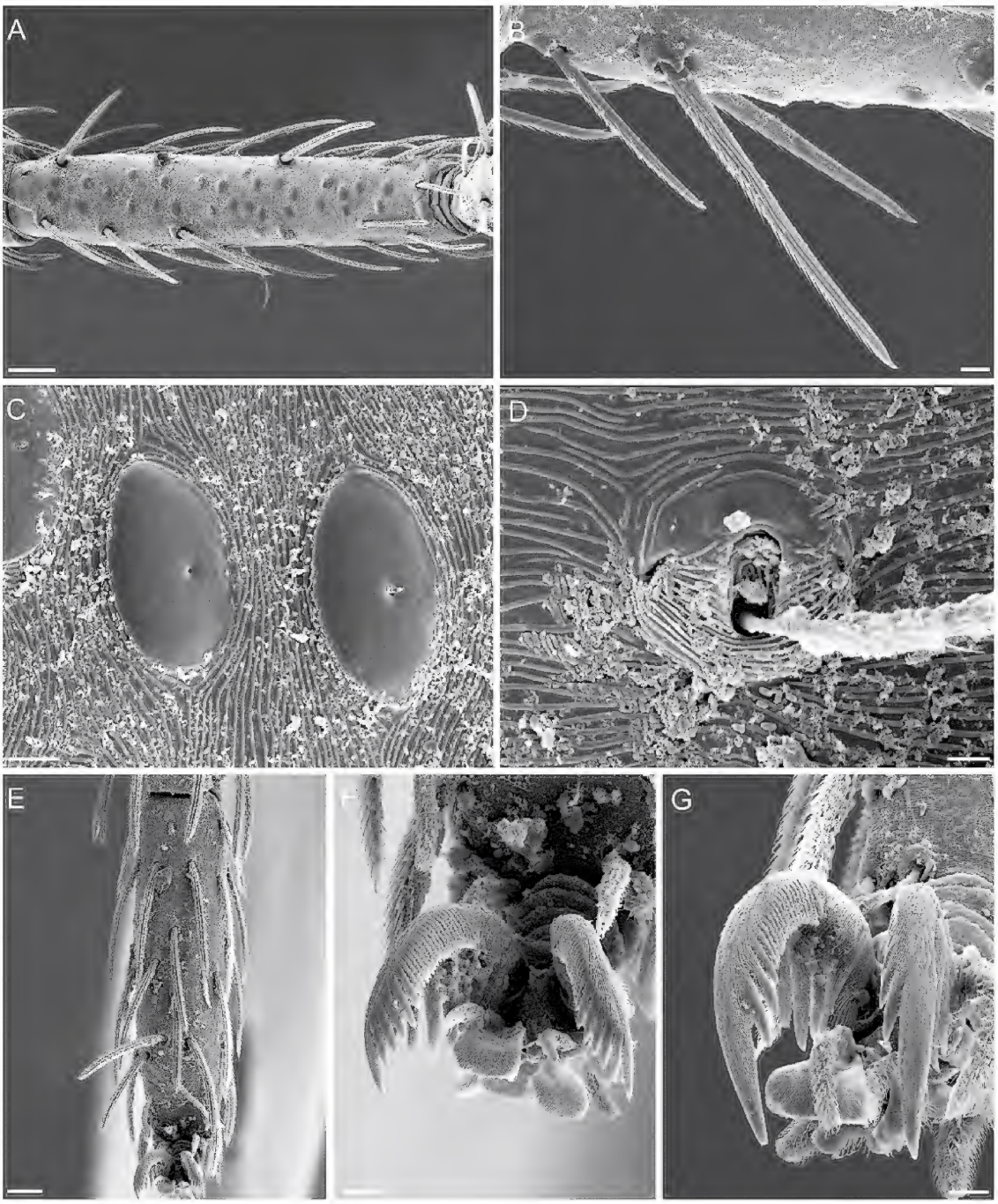


Fig. 83. *Coxapopha diblemma* Platnick, male. **A.** Tibia I, ventral view. **B.** Tibia I, spines, lateral view. **C.** Tibia I, ventral surface, oval glands. **D.** Trichobothrial base from tibia IV, dorsal view. **E.** Tarsus II, dorsal view. **F.** Claws, leg II, anterior view. **G.** Same, leg IV. Scale bars: 2 μm (D), 5 μm (C, F, G), 10 μm (B), 20 μm (E), 50 μm (A).

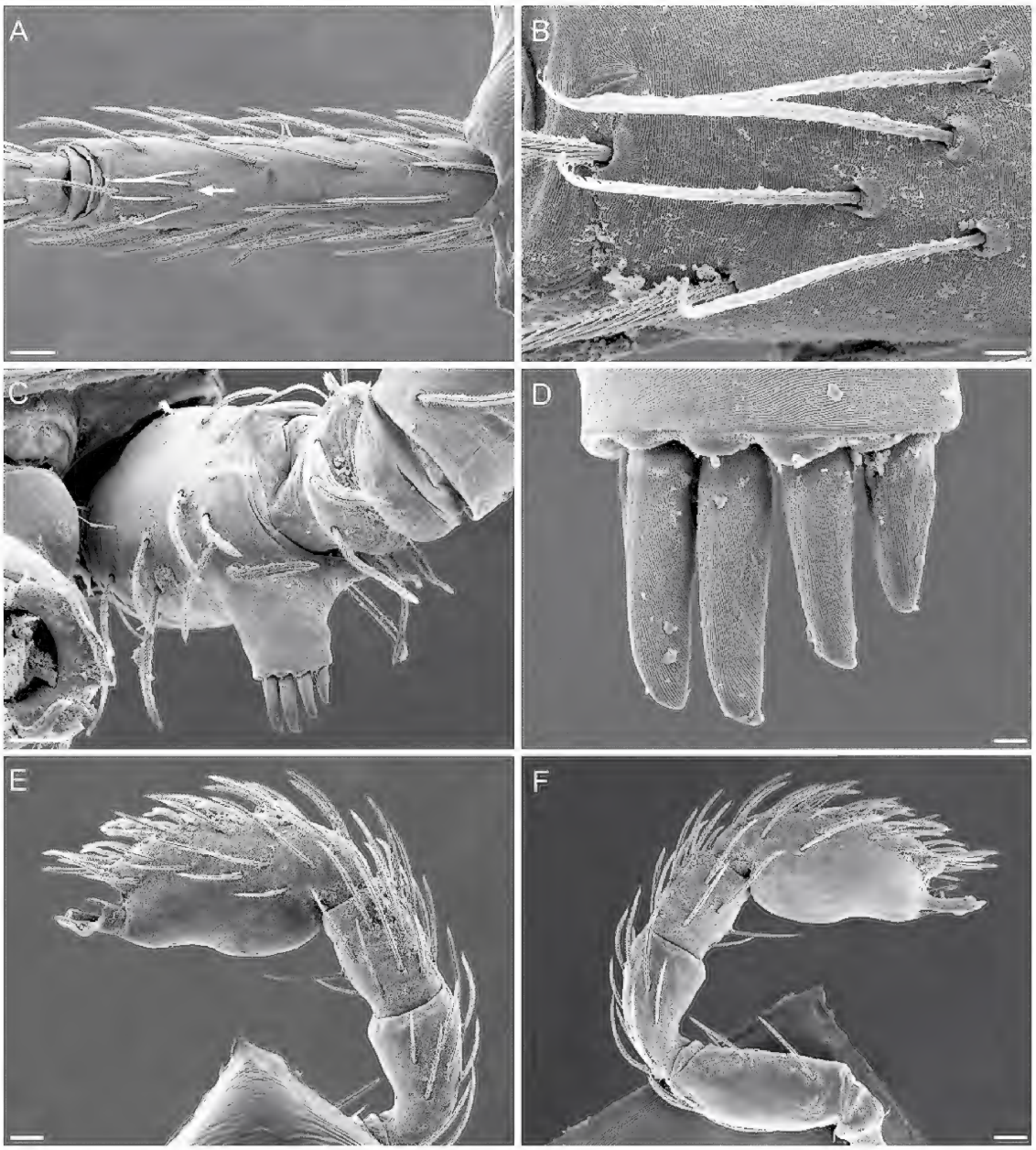


Fig. 84. *Coxapopha diblemma* Platnick, male. **A.** Tibia IV, ventral view. Arrow: group of specialized setae. **B.** Detail of A, showing group of specialized setae. **C.** Coxa IV, lateral view, showing hand-shaped apophysis. **D.** Hand-shaped apophysis, peg setae, lateral view. **E.** Pedipalp, prolateral view. **F.** Same, retrolateral view. Scale bars: 5 μm (D), 10 μm (B), 50 μm (A, C, E, F).

unambiguous synapomorphy of the clade *Z. clandestinus* + *Z. moffetti*.

15. Male, DS, fusion: 0, not fused to ES; 1, fused to ES. A fused DS is an unambiguous synapomorphy of *Zyngoonops*. Deleting this character does not alter the topologies of the MPTs.

16. Male, abdomen, dorsum, shape: 0, without constriction; 1, with constriction. Males of *Antoonops* have a constricted abdomen,

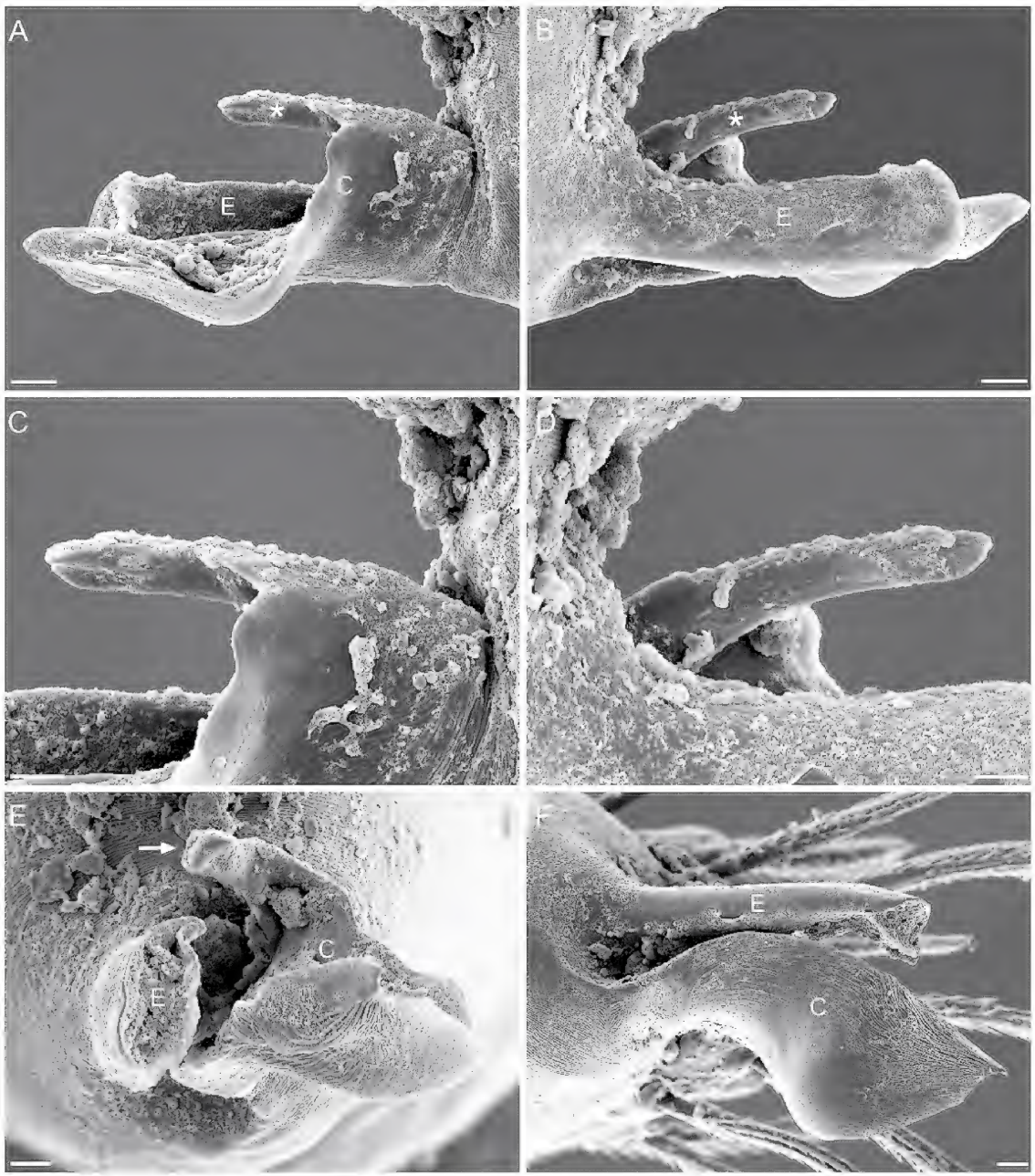


Fig. 85. *Coxapopha diblemma* Platnick, male. **A.** Embolus and conductor, prolateral view. Asterisk: dorsal projection. **B.** Same, retrolateral view. Asterisk: dorsal projection. **C.** Dorsal projection, prolateral view. **D.** Same, retrolateral view. **E.** Embolus and conductor, anterior view. Arrow: dorsal projection. **F.** Same, ventral view. Abbreviations: **C,** conductor; **E,** embolus. Scale bars: 5 μm (C–F), 10 μm (A, B).

which enhances their antlike appearance (Fannes and Jocqué, 2008: figs. 16, 18).

17. Sperm pore, position: 0, situated in front of anterior spiracles; 1, situated at level of posterior spiracles; 2, situated behind posterior spiracles. *Zyngoonops* and *C. diblemma* are here coded as having state 2. However, in *C. diblemma*, the sperm pore is

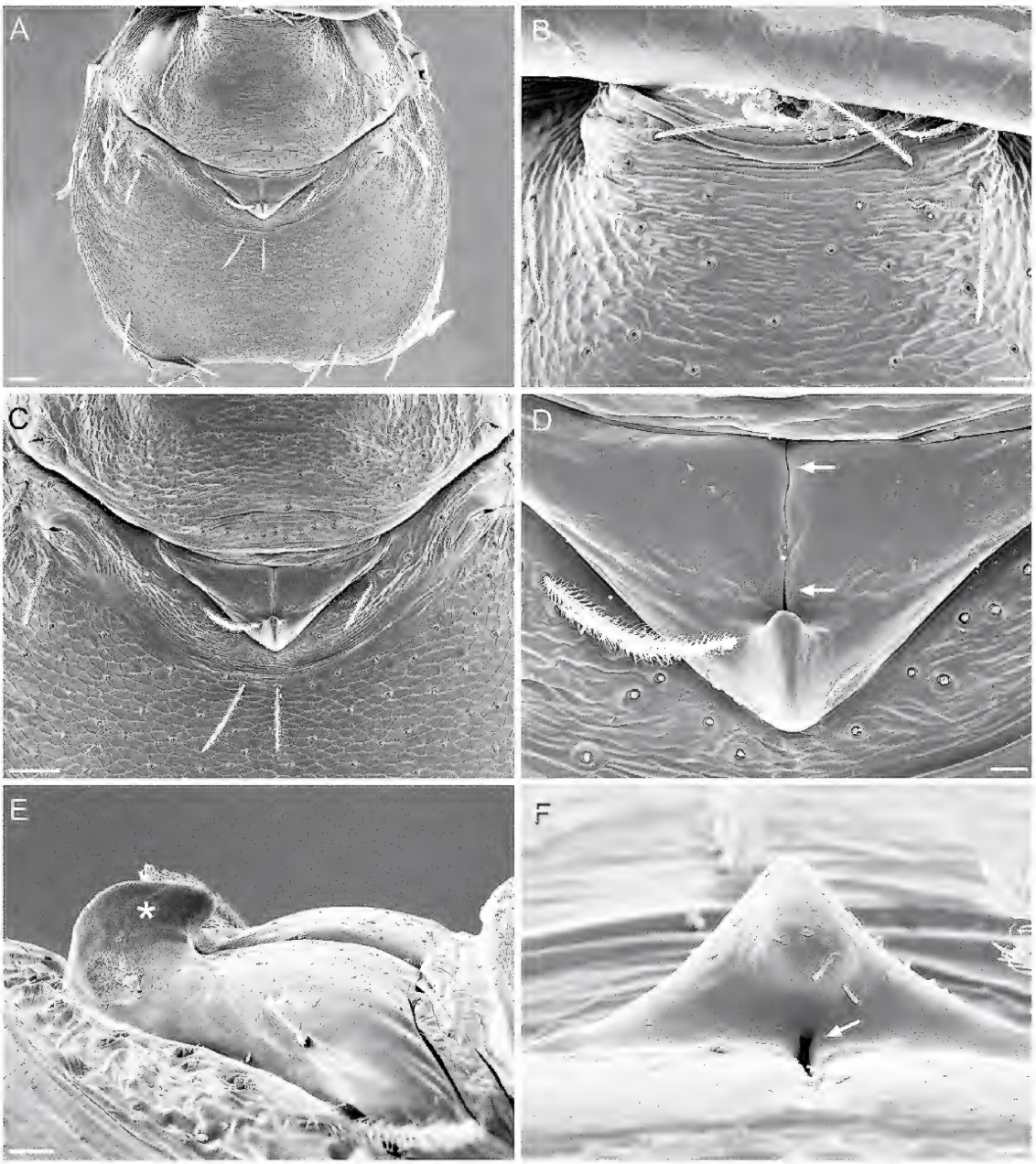


Fig. 86. *Coxapopha* sp., female. **A.** ES and PES, ventral view. **B.** Pedicel tube, ventral view. **C.** Epigastric region, ventral view. **D.** Epigastric scape, ventral view. Arrows: slit. **E.** Same, lateral view. Asterisk: elevated posterior tip. **F.** Elevated posterior tip, anterior view. Arrow: slit. Scale bars: 5 μm (F), 10 μm (D, E), 20 μm (B), 50 μm (A, C).

situated relatively close to the posterior spiracles (fig. 82B), and it is placed near the tip of a long projection, making comparisons with other species difficult (fig. 82A–D). The analysis was therefore repeated with *C. diblemma* coded as having state 1. The same topologies were recovered.

18. Groove connecting posterior spiracles: 0, present; 1, absent or indistinct. In *O. pulcher* and *M. thevenot*, the posterior spiracles are

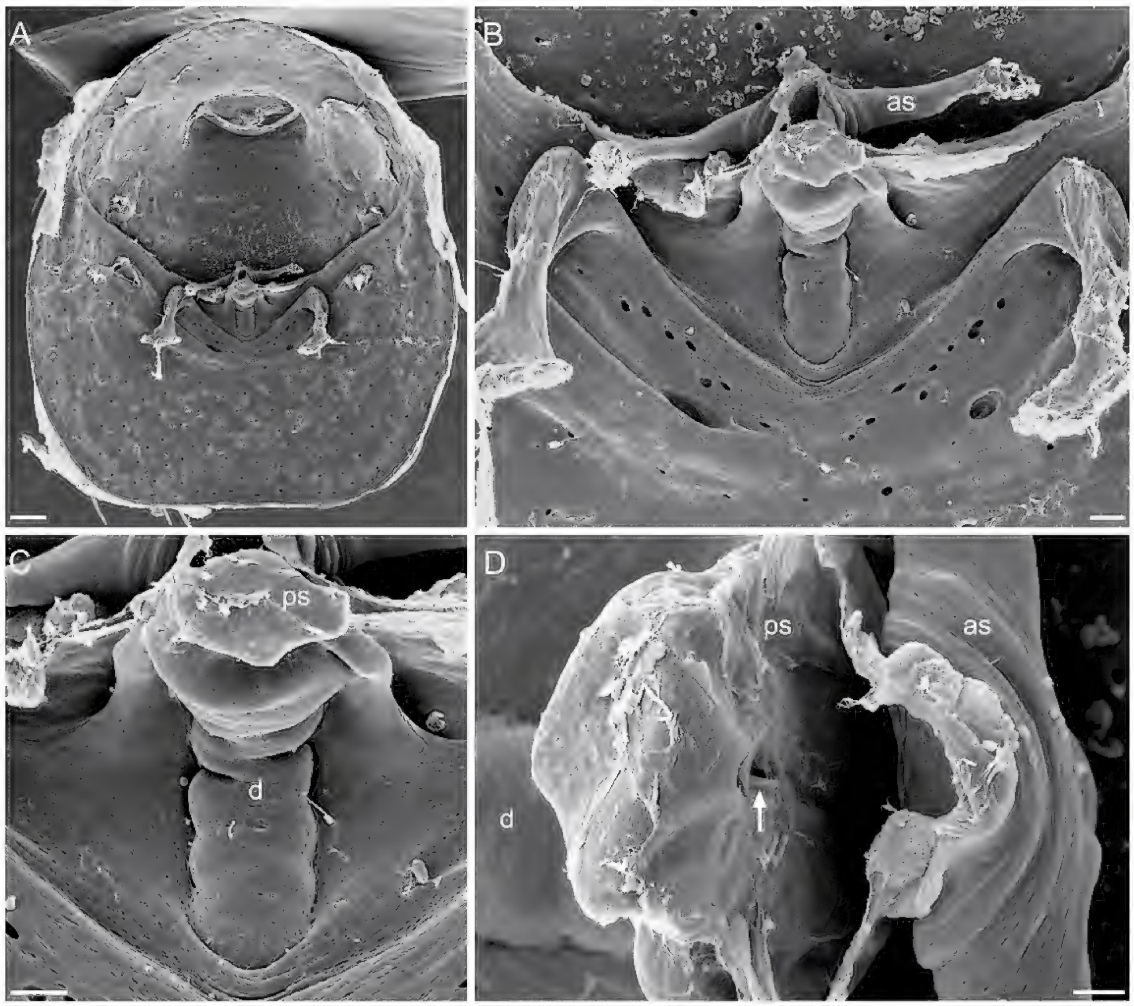


Fig. 87. *Coxapopha* sp., female. **A.** ES and PES, dorsal view. **B.** Internal genitalia, dorsal view. **C.** Posterior sclerite and duct, dorsal view. **D.** Anterior and posterior sclerite, dorsal view. Arrow: slitlike opening. Abbreviations: **as,** anterior sclerite; **d,** duct; **ps,** posterior sclerite. Scale bars: 5 μm (D), 10 μm (B, C), 50 μm (A).

connected by an external groove (Platnick and Dupérré, 2009; Fannes, 2010b: figs. 26–30; fig. 96A). Absence of a distinct groove is a synapomorphy of the *Zyngoonops* group. Deleting this character does not alter the topology of the MPTs.

19. Female, ALS, piriform gland spigots: 0, none; 1, two; 2, three. State 2 is a synapomorphy of *Antoonops*.

20. Female, PMS, spigots: 0, one; 1, two; 2, four. This character is phylogenetically uninformative in the current analysis. The character has eight most parsimonious optimizations; the optimization chosen (fig. 98) minimizes spigot gains.

21. Female, PLS, spigots: 0, two; 1, three; 2, six. This character is phylogenetically uninformative. The character has eight most parsimonious optimizations; the optimization chosen (fig. 98) minimizes spigot gains.

22. Male, ALS, piriform gland spigots: 0, none; 1, two; 2, three. In the species examined here, the males have the same number of piriform gland spigots as the females. However, some oonopids show sexual dimorphism in piriform spigot number (see, e.g., Platnick

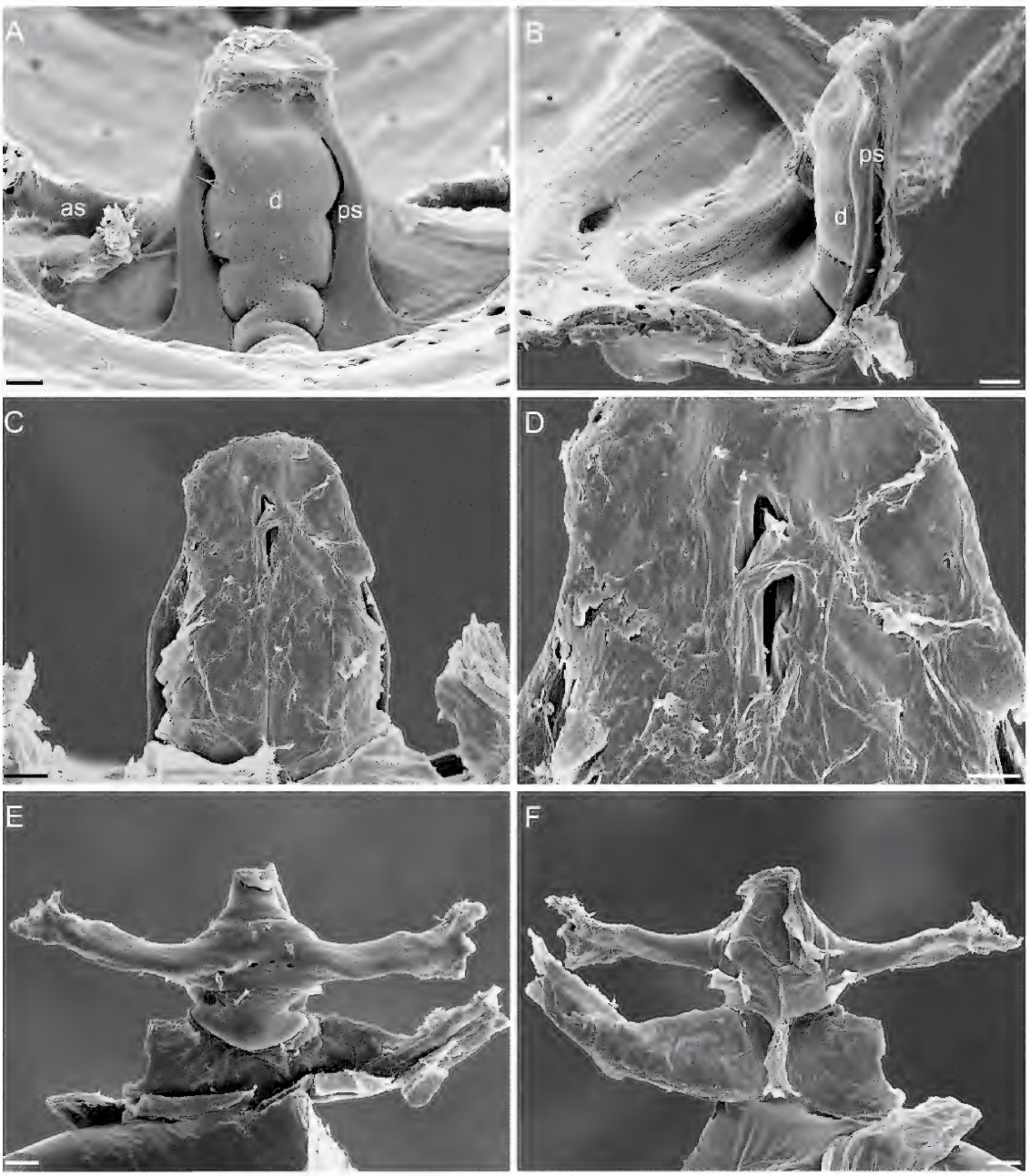


Fig. 88. *Coxapopha* sp., female. **A.** Posterior sclerite and duct, posterior view. **B.** Same, lateral view. Asterisk: elevated posterior tip of scape. **C.** Posterior sclerite, anterior view. **D.** Detail of C, showing slitlike opening. **E.** Anterior sclerite, anterior view. **F.** Same, posterior view. Abbreviations: **as,** anterior sclerite; **d,** duct; **ps,** posterior sclerite. Scale bars: 5 μm (D), 10 μm (A, C, E, F), 20 μm (B).

and Dupérré, 2011a, 2011b). This character can thus be regarded as independent from character 19. Deleting this character does not alter the topology of the MPTs.

23. Male, PMS, spigots: 0, one; 1, two. The character has three most parsimonious optimizations; the optimization chosen (fig. 98) minimizes spigot gains.

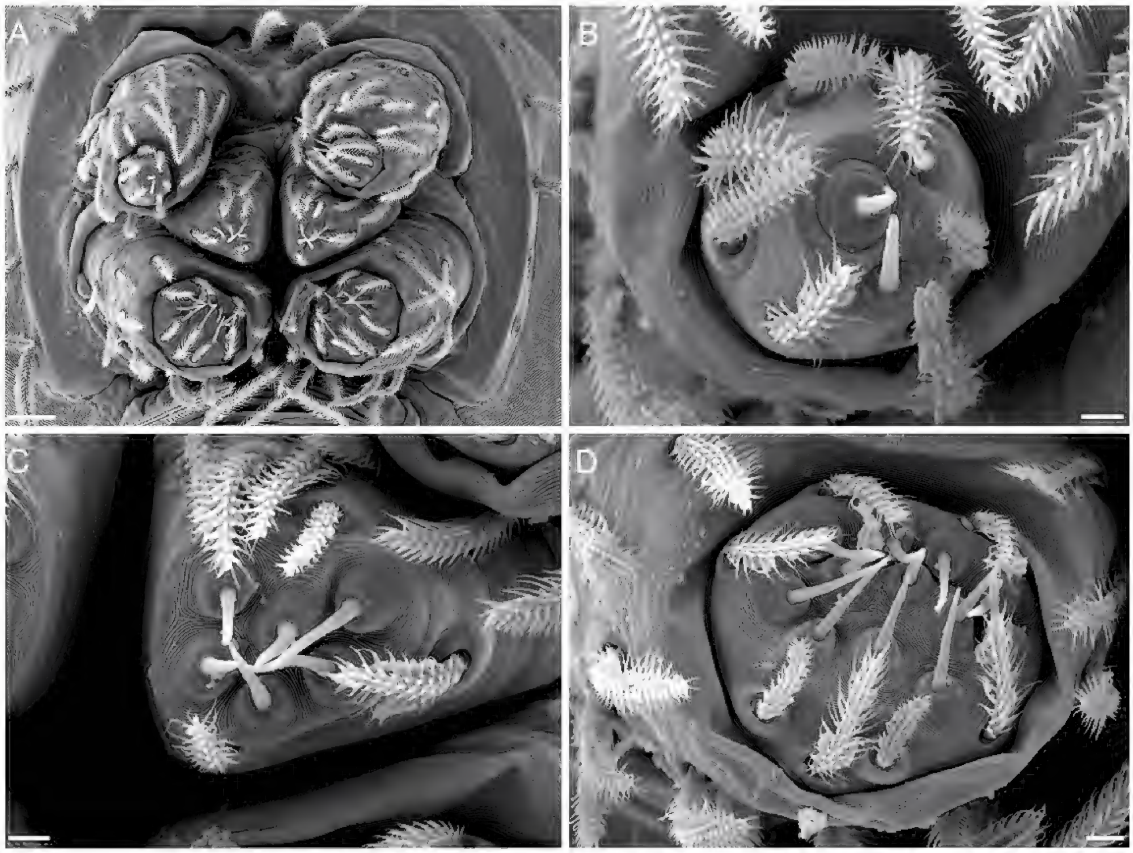


Fig. 89. *Coxapopha* sp., female. **A.** Spinnerets, posterior view. **B.** ALS, posterior view. **C.** PMS, posterior view. **D.** PLS, posterior view. Scale bars: 3 μm (B–D), 15 μm (A).

24. Male, PLS, spigots: 0, two; 1, three. The character has six most parsimonious optimizations; the optimization chosen (fig. 98) minimizes spigot gains.

Male mouthparts

25. Male, labium, length/width: 0, less than twice as wide as long; 1, more than twice as wide as long. Labium length was measured along the midline; width was measured at the widest point. State 1 is here a synapomorphy of the *Zyngoonops* group. In females of the *Zyngoonops* group, the labium is not as wide as in males (figs. 4D, 41E; Fannes and Jocqué, 2008: fig. 41).

26. Male, endites: 0, not modified as in the *Zyngoonops* group; 1, modified as in the *Zyngoonops* group. Males of the *Zyngoonops* group have heavily modified endites. The endites are enlarged and have a peculiar shape, with a short median margin (figs. 57C, 79C, 91C). The posteromedian part is somewhat bulging (figs. 57C, 66E). The ventral surface is heavily sclerotized except for a diagonal band (figs. 104F, 106H). The setae s1–3 are generally situated very close together (e.g., figs. 66D, 79D, 92B; in other oonopids these setae are usually more widely spaced; see fig. 97B). There is a pocket in the median wall of the endite (figs. 20C, D, 80D, 92D); the anterior edge of the pocket continues into a projection (the median projection, mp; figs. 20D, 58D); the posterior edge continues into a ventral groove that runs between the median projection and the setae s1–3. The groove is relatively short, usually ending near or before seta s5 (figs. 19C, E, 58D, 79D, 91E, 92D).

The median projection is usually not the only protuberance on the endites. Most

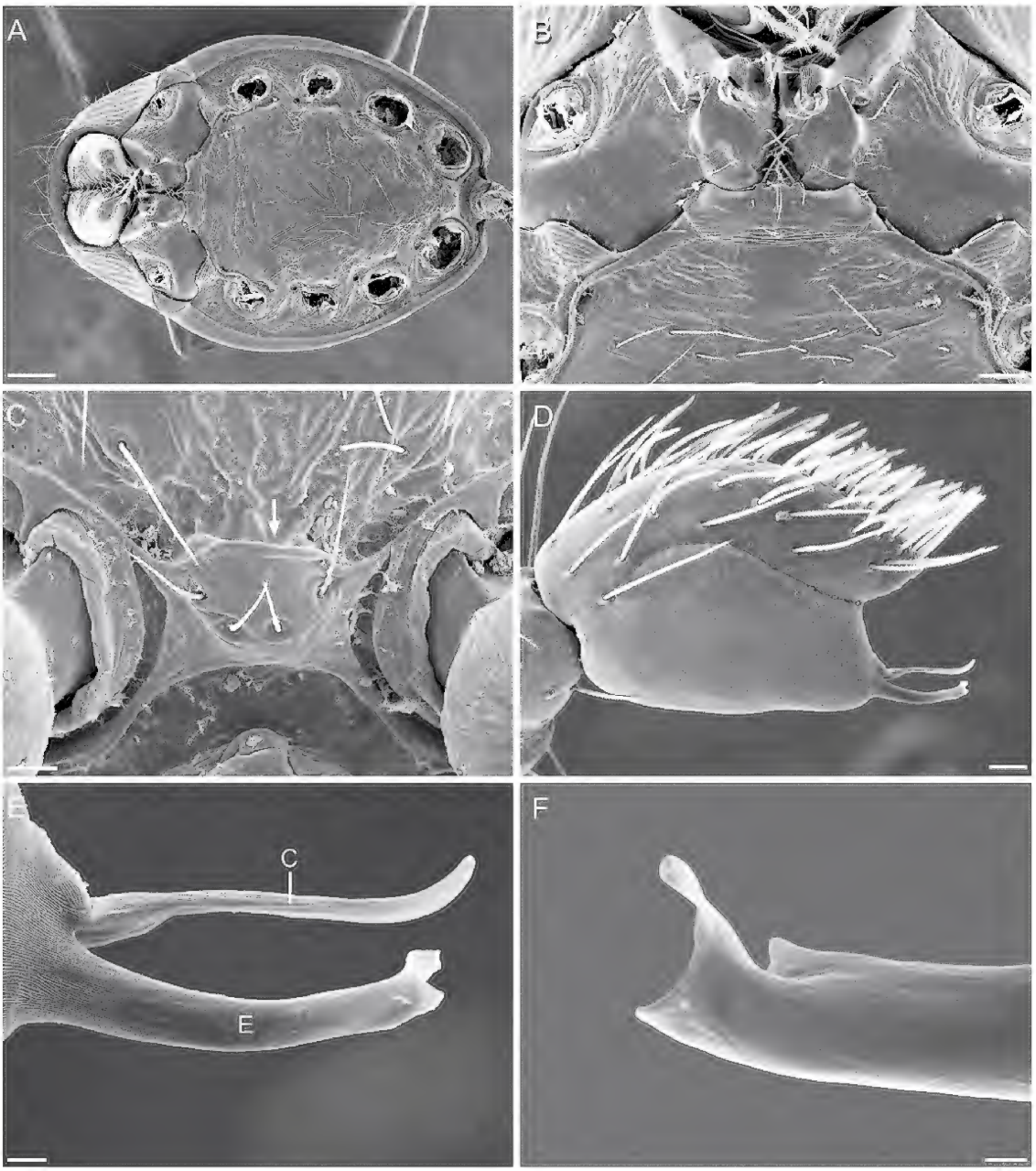


Fig. 90. *Antoonops corbulo* Fannes and Jocqué, male. **A.** Carapace, ventral view. **B.** Mouthparts, ventral view. **C.** Sternum, posterior part, ventral view. Arrow: ridge. **D.** Bulb, retrolateral view. **E.** Embolus (E) and conductor (C), retrolateral view. **F.** Tip of embolus, retrolateral view. Scale bars: 2 μm (F), 5 μm (E), 10 μm (C), 20 μm (B, D), 50 μm (A).

species have one or more additional projections (see, e.g., figs. 19C, 25E, 47E, 57E). Establishing homologies among these projections is not a trivial task, for their size and shape varies considerably across and within genera (see, e.g., figs. 25B, 46D, 57E). Several homology hypotheses are proposed here (projections P1 to P5; chars. 29–34).

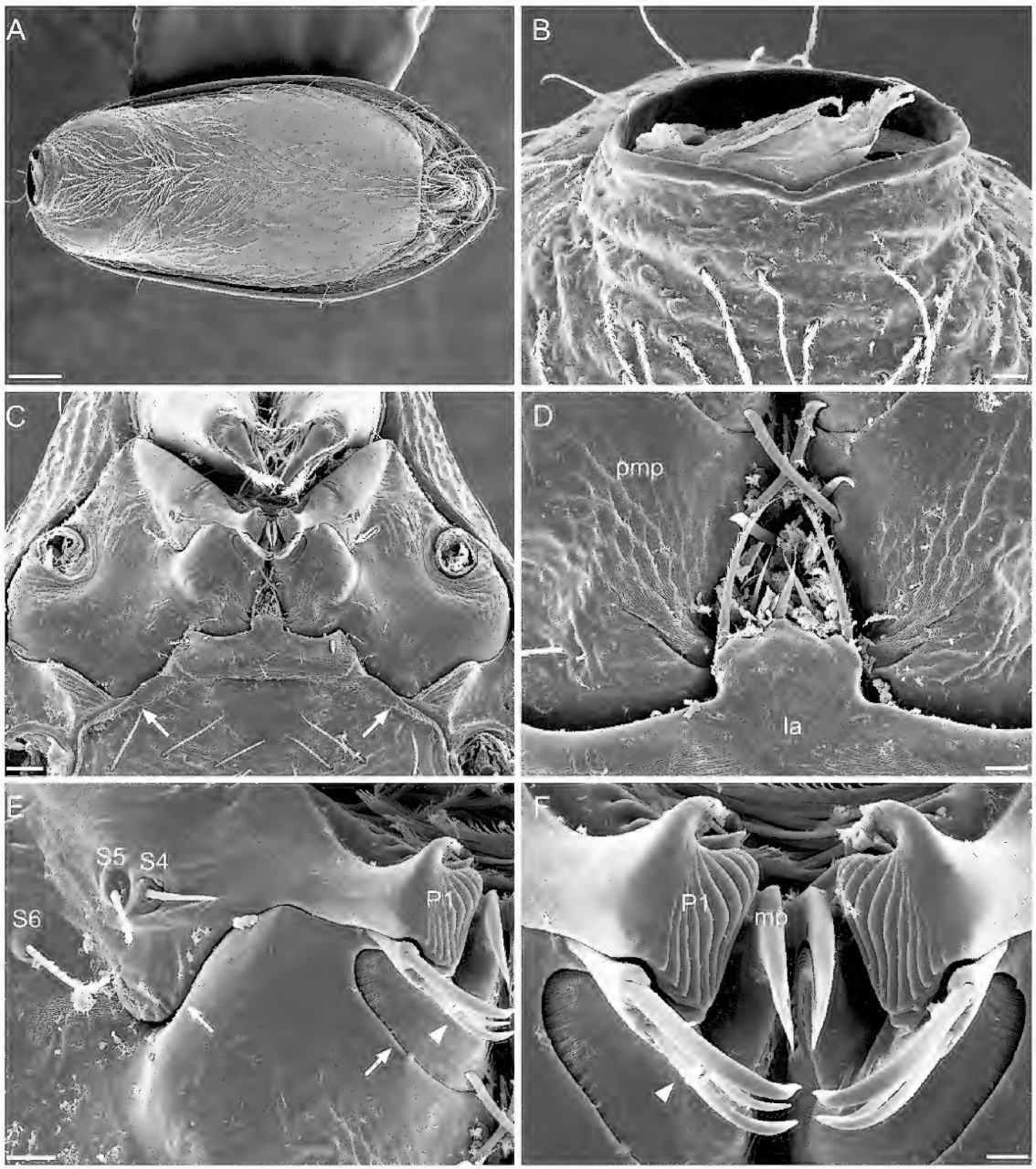


Fig. 91. *Antoonops nebula* Fannes and Jocqué, male. **A.** Abdomen, ventral view. **B.** Pedicel tube, ventral view. **C.** Mouthparts, ventral view. Arrows: oblique ridges. **D.** Labium, anterior part, ventral view. **E.** Right endite, median part, ventral view, showing setae 1–3 (arrowhead) and setae 4–6 (s4–6). Arrows: groove. **F.** Endites, projections, ventral view. Arrowhead: setae 1–3. Abbreviations: **la,** labium; **mp,** median projection; **P,** projection; **pmp,** posteromedian part of endite. Scale bars: 5 μm (D, F), 10 μm (B, E), 20 μm (C), 100 μm (A).

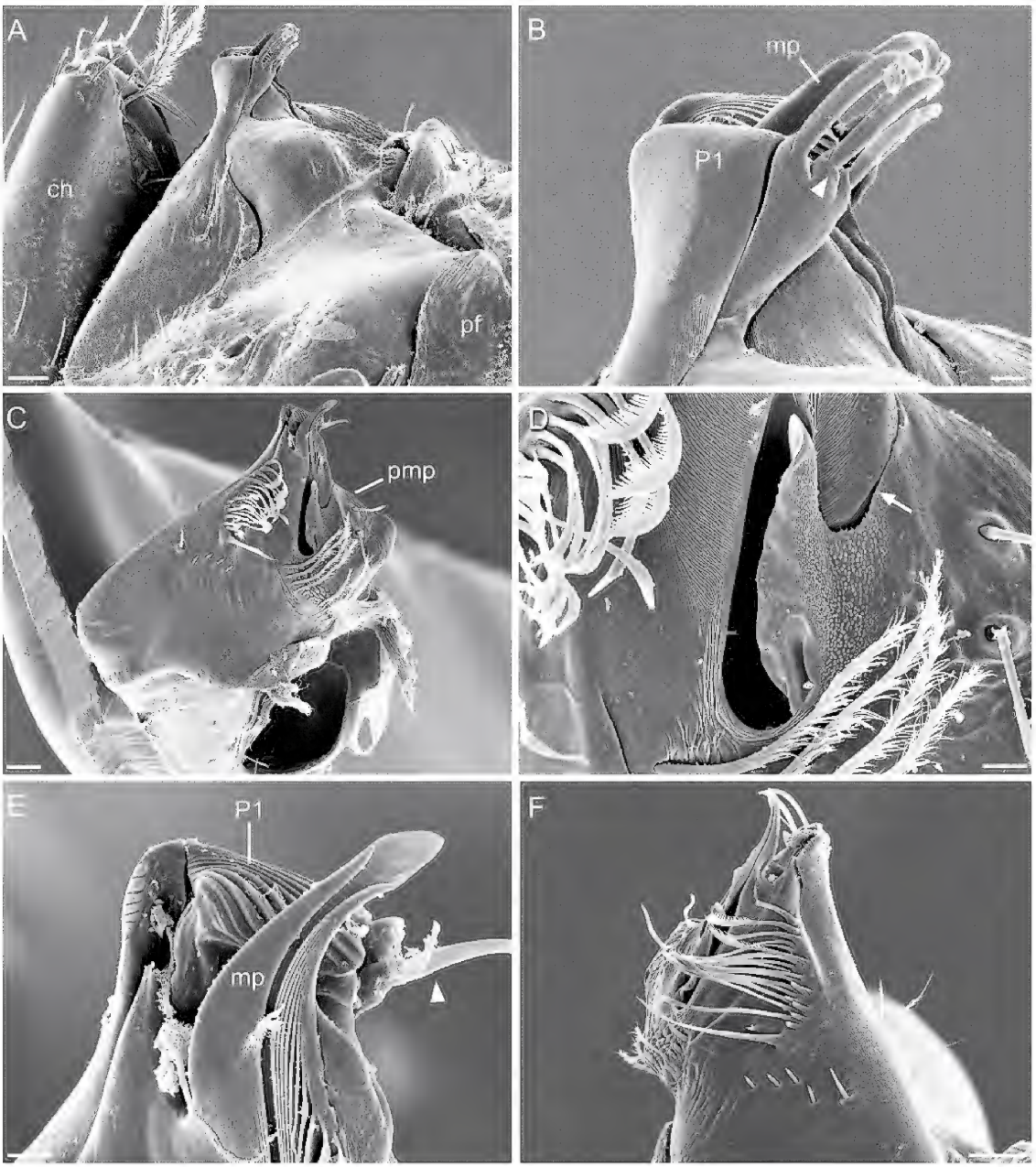


Fig. 92. *Antoonops nebula* Fannes and Jocqué, male. **A.** Endites, lateral view. **B.** Detail of A, showing median projection, P1 and setae 1–3 (arrowhead). **C.** Left endite, median view. **D.** Detail of C, showing pocket and groove (arrow). **E.** Left endite, median projection and P1, median view. Arrowhead: setae 1–3. **F.** Right endite, anterior view. Abbreviations: **ch,** chelicera; **mp,** median projection; **P,** projection; **pf,** pleural flap; **pmp,** posteromedian part of endite. Scale bars: 5 μm (B, D, E), 20 μm (A, C, F).

One could argue that characters 26 (modified endites), 7 (pleural flaps), and 3 (extended corners) are not independent. These features always occur together; hence, they may constitute a single functional complex. The analysis was therefore repeated with characters 7 and 3 inactivated; this did not affect the topology of the MPTs.

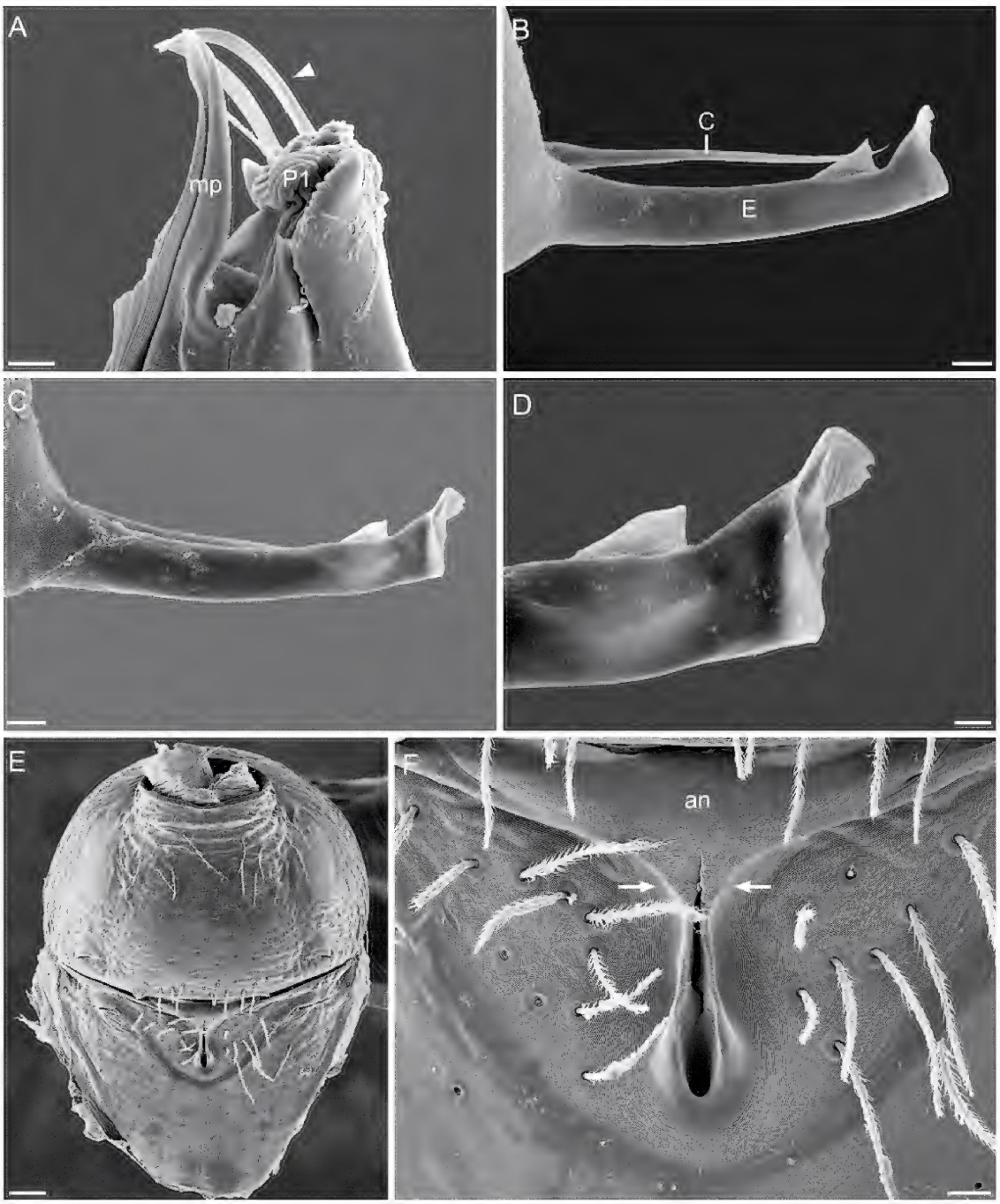


Fig. 93. *Antoonops nebula* Fannes and Jocqué, male (A–D) and female (E, F). **A.** Right endite, median projection, P1 and setae 1–3 (arrowhead), anterior view. **B.** Embolus (E) and conductor (C), retrolateral view. **C.** Other specimen, embolus, retrolateral view. **D.** Detail of C, showing tip of embolus. **E.** ES and PES, ventral view. **F.** Epigastric region, ventral view. Arrows: anterior edge extending toward copulatory opening. Abbreviations: **an,** anterior edge of PES; **mp,** median projection; **P,** projection. Scale bars: 2 μm (D), 5 μm (A–C), 10 μm (F), 50 μm (E).

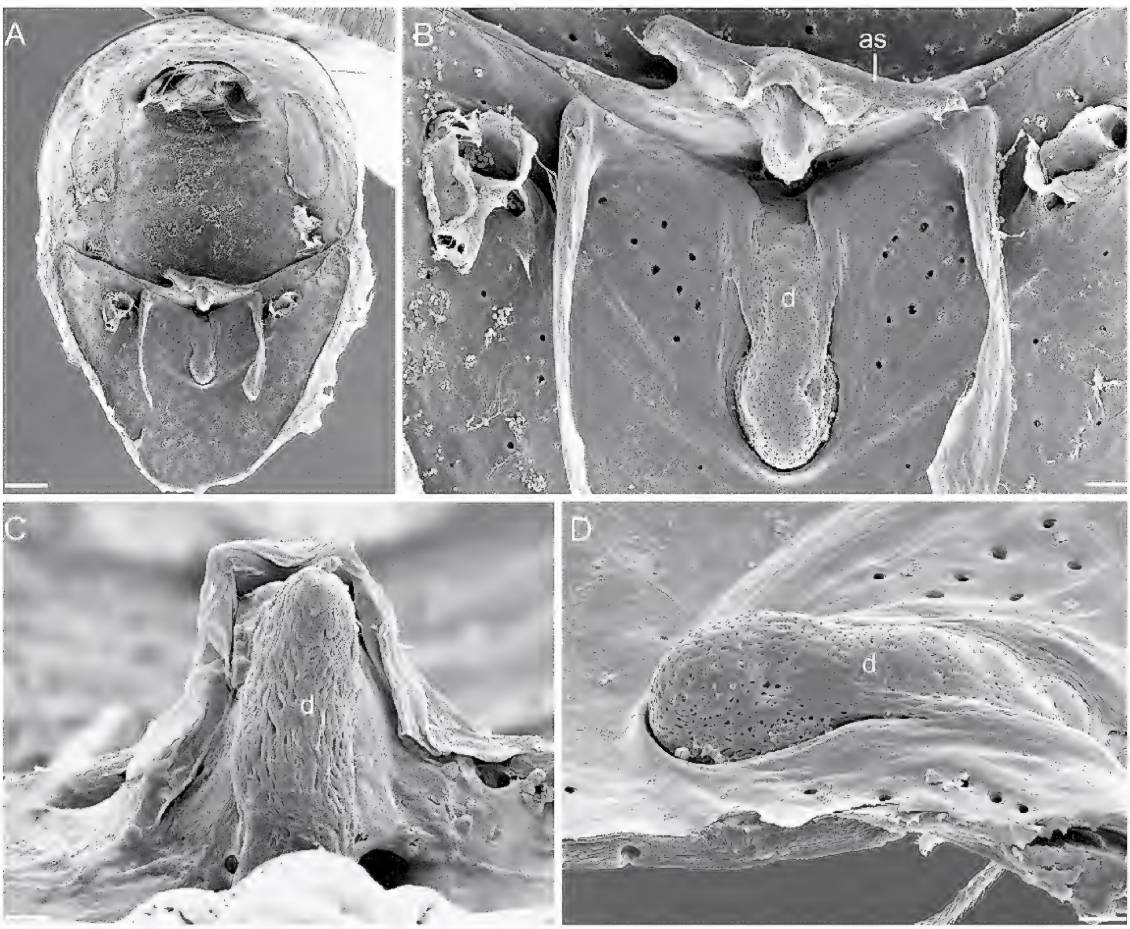


Fig. 94. *Antoonops nebula* Fannes and Jocqué, female. **A.** ES and PES, dorsal view. **B.** Internal genitalia, dorsal view. **C.** Ascending part of duct, posterior view. **D.** Posterior part of duct, lateral view. Abbreviations: **as,** anterior sclerite; **d,** duct. Scale bars: 5 μm (C), 10 μm (B, D), 40 μm (A).

27. Median projection, length relative to posteromedian part: 0, 0.3–1.3 times as long as pmp; 1, 3–5 times as long as pmp; 2, more than 15 times as long as pmp. Lengths were measured in ventral view (see fig. 101). Deleting this character does not alter the topologies of the MPTs.

28. Median projection, shape: 0, projecting anteriorly; 1, projecting posteriorly. This character aims to capture some of the variation in the form of the median projection. The character is considered inapplicable for taxa with a very short median projection (*Z. redii*). When *Z. redii* is coded as having state 0 or 1, there is no difference to the resulting topologies. Posteriorly projecting mps are a synapomorphy of *Antoonops*.

29. Projection P1: 0, absent; 1, present. Projection P1 is present in *Antoonops*, *Z. redii,* and *Z. goedaerti*. The projection is situated immediately anterior to the groove (figs. 19C, E, 25F, 91E) and has a ventral surface that is longitudinally ribbed (figs. 19C, F, 25F, 91F). In *Z. redii*, the ventral surface is slightly vaulted (figs. 19C, F, 20G). In *Z. goedaerti*, the P1 is situated very close to the median projection (figs. 25B, E, F, 26E, F). *Z. rockoxi* has been scored as unknown (?) because the posterior part of the endites is obscured by dust.

30. Projection P1, position relative to mp: 0, lateral of mp (*A. corbulo, A. nebula*); 1, posterior of mp (*Z. redii*, *Z. goedaerti*). Deleting this character does not alter the topologies of the MPTs.

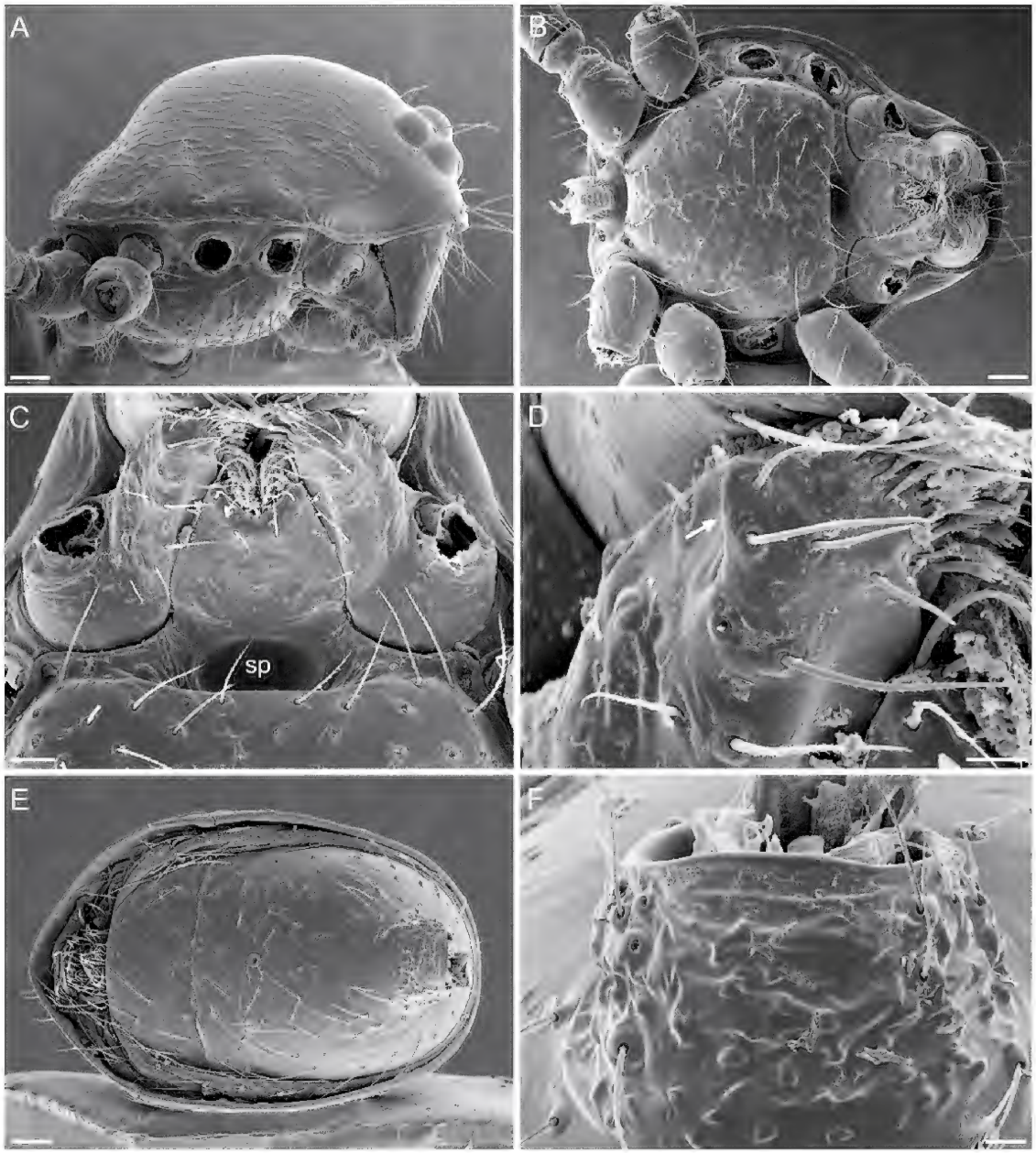


Fig. 95. *Melchisedec thevenot* Fannes, male. **A.** Carapace, lateral view. **B.** Same, ventral view. **C.** Mouthparts and sternal pouch (sp), ventral view. **D.** Right endite, anterior part, ventral view. The male of *M. thevenot* has a small protuberance (arrow) on each endite. **E.** Abdomen, ventral view. **F.** Pedicel tube, ventral view. Scale bars: 10 μm (D, F), 20 μm (C), 50 μm (A, B, E).

31. Projection P2: 0, absent; 1, present. Projection P2 is present in all *Zyngoonops* species except *Z. redii*. It is a large structure that projects toward the mp (figs. 25E, 32E, 46C, D, 57D). The median surface is often strongly ribbed (e.g., *Z. goedaerti*, *Z. swammerdami*; figs. 26D, 58E). In all species, the anterior edge is partly serrated (figs. 26B, 39D, 57F, 67C).

In *Z. beatriceae*, *Z. chambersi*, *Z. swammerdami,* and *Z. marki*, the P2 appears to be supported by a smaller, somewhat cone-

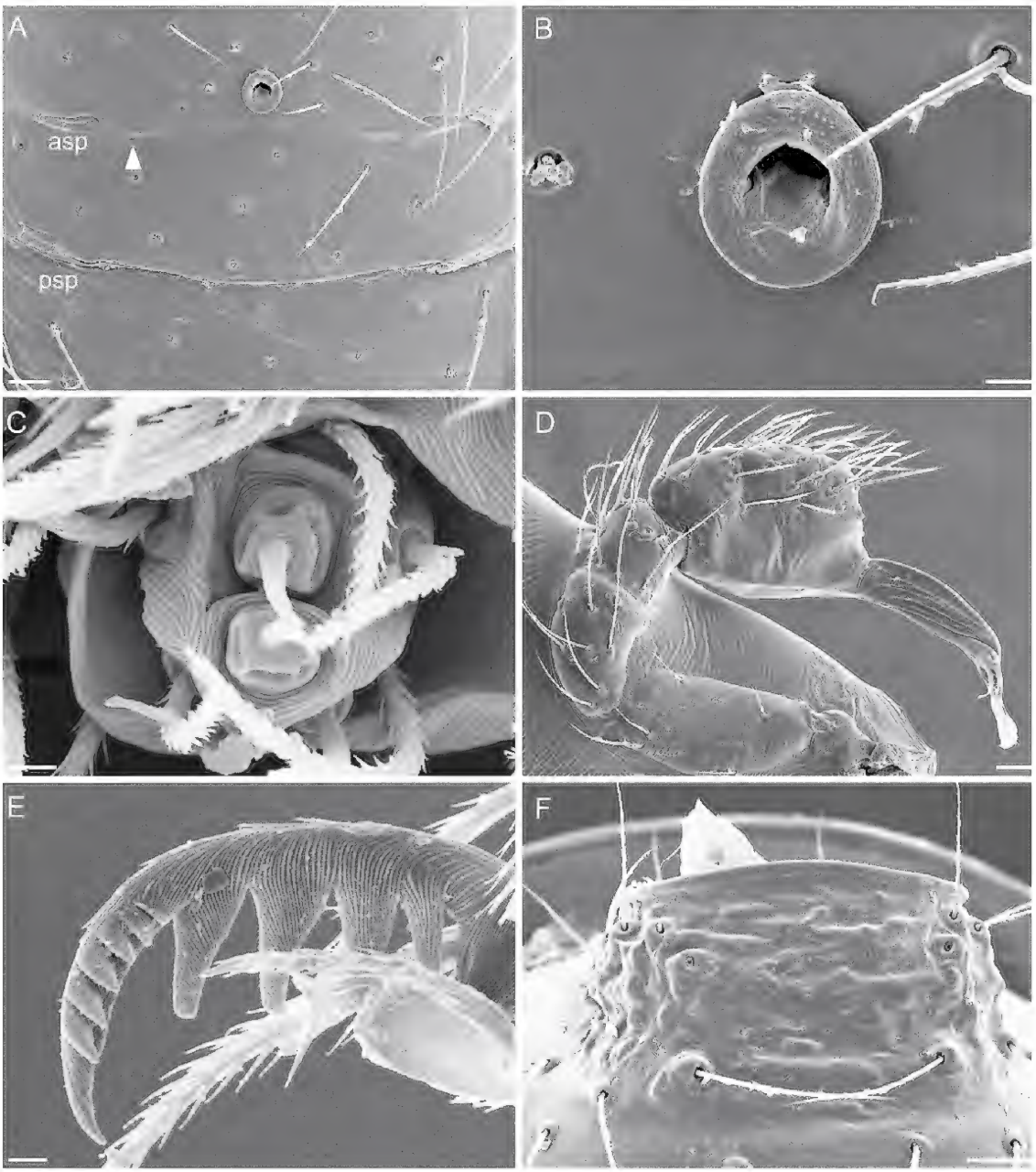


Fig. 96. *Melchisedec thevenot* Fannes, male (A–D) and female (E, F). **A.** Epigastric region, ventral view, showing sperm pore, additional orifice (arrowhead), anterior spiracle (asp) and posterior spiracle (psp). **B.** Sperm pore, ventral view. **C.** PLS, posterior view. **D.** Pedipalp, prolateral view. **E.** Proclaw, leg IV, median surface. **F.** Pedicel tube, ventral view. Scale bars: 2 μm (C, E), 5 μm (B), 20 μm (A, D, F).

shaped projection (P4; figs. 39E, F, 47E, 48A, 58E, F, 67F). This projection is here not coded as a separate character. When P4 is coded as a separate character, there is no difference to the resulting topologies.

32. Projection P2, shape: 0, elongated; 1, platelike. Projection P2 varies greatly in shape and size among species. This character tries to capture some of the variation in shape. In most species, the P2 is a relatively

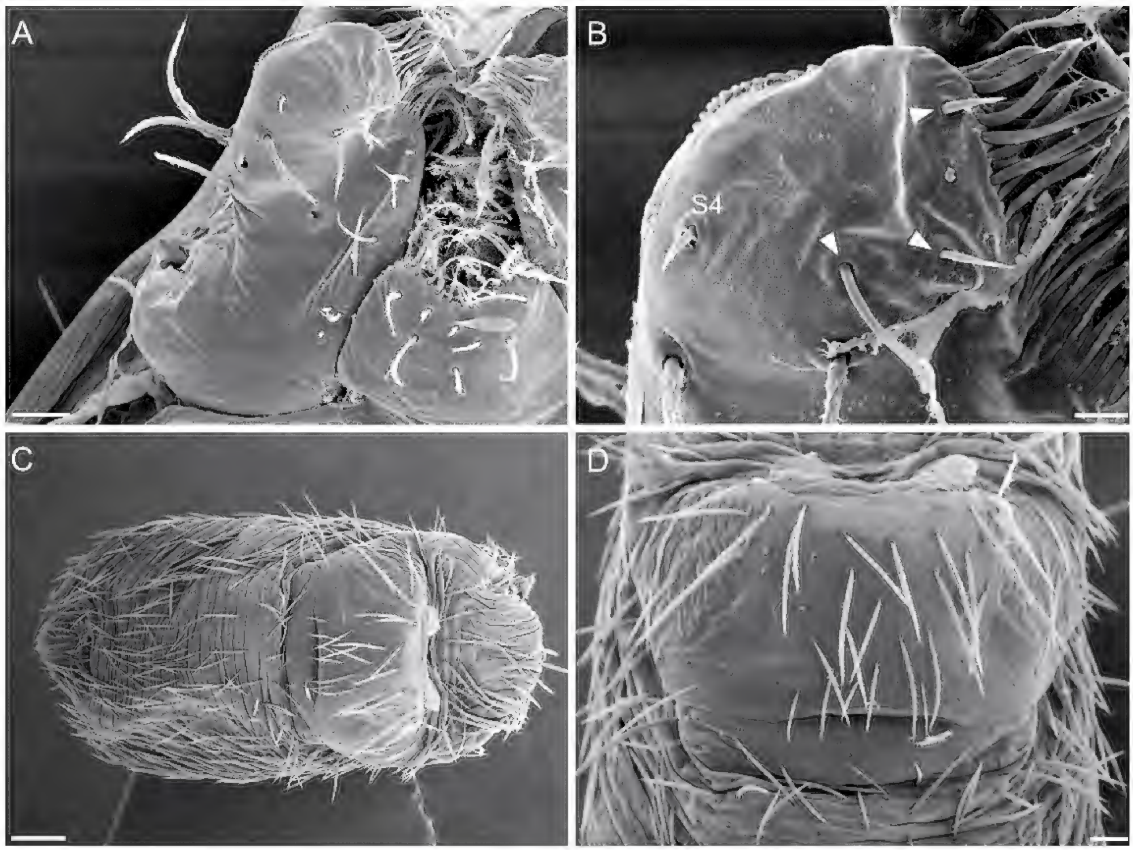


Fig. 97. *Oonops pulcher* Templeton, male. **A.** Right endite, ventral view. **B.** Right endite, anterior part, ventral view, showing setae 1–3 (arrowheads) and seta 4 (s4). **C.** Abdomen, ventral view. **D.** Epigastric region, ventral view. Scale bars: 10 μm (B), 30 μm (A, D), 100 μm (C).

broad, somewhat platelike structure (*Z. beatriceae*, figs. 38F, 39A; *Z. chambersi*, fig. 46D; *Z. swammerdami*, fig. 57D–F; *Z. marki*, fig. 67A). In *Z. goedaerti* and *Z. rockoxi*, however, the P2 is not platelike but rather elongated (figs. 25B, 26A, 32D, 33A). In species with a broad P2, the shaft of seta 4 rests on the surface of the projection (figs. 38F, 57F, 67A). In *Z. goedaerti* and *Z. rockoxi*, the P2 is situated anterior of s4 (figs. 25B, 32D). Deleting this character does not substantially alter the results (equal weights yields 20 trees, among which the preferred topologies; implied weighting (k = 1, 3, 6, 20, 50, 100) results in the preferred topologies).

33. Projection P3: 0, absent; 1, present. Projection P3 is present in *Z. beatriceae*, *Z. chambersi*, *Z. swammerdami,* and *Z. marki*. This cone-shaped projection is situated anterior and lateral to projection P2 (figs. 38F, 46D, F, 57E, 67C). Often, the lateralmost part of the P2 rests on the P3 (e.g., fig. 46F). The surface of P3 appears smooth. Its size varies considerably among species (see, e.g., figs. 46D, 57E).

34. Projection P5: 0, absent; 1, present. Projection P5 is present in *Z. beatriceae* and *Z. chambersi*. It is a relatively large, somewhat triangular, crestlike structure (figs. 39D–F, 47C, E, 48A, B). P5 is situated anterior of P2 and P4. When the endites are observed from a ventral point of view, only a small part of the projection is visible (fig. 38F).

Z. goedaerti and *Z. rockoxi* may have a homolog of the P5 projection. *Z. goedaerti* has three projections of uncertain homology (Pa, Pb, and Pc); one of these projections, Pa, is crestlike and situated anterior to the P2 (figs. 25B, E, 26A, D). *Z. rockoxi* has one

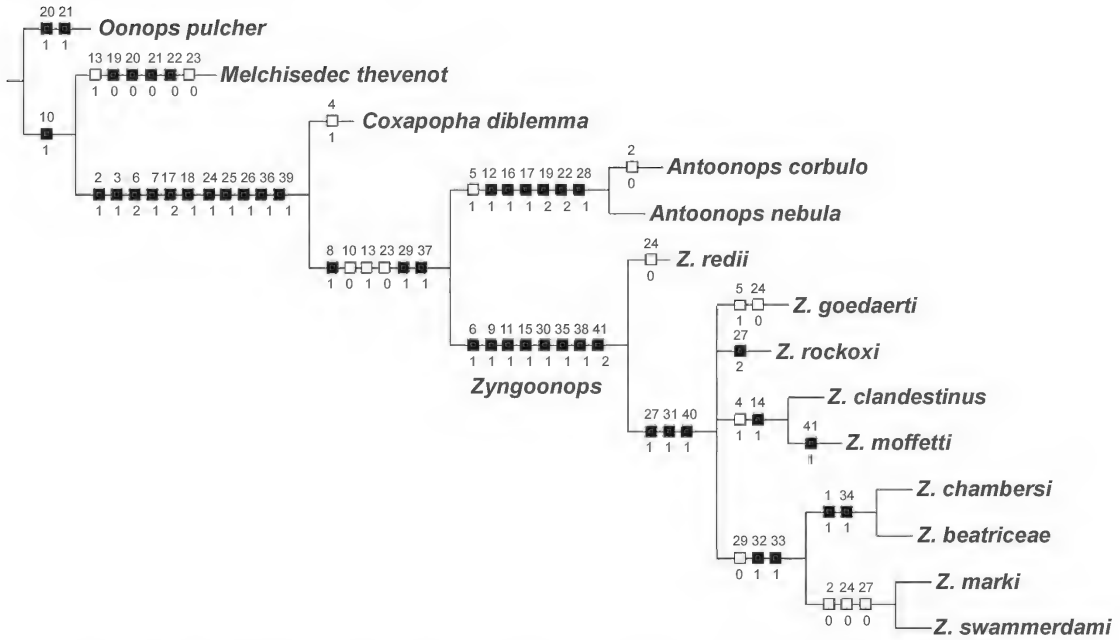


Fig. 98. One of the three trees found by implied weighting (see Results). All character changes are shown; ambiguous optimizations were generally resolved to favor parallel losses or simplification (see Analyses). Black squares represent nonhomoplasious character changes, white squares represent homoplasious changes.

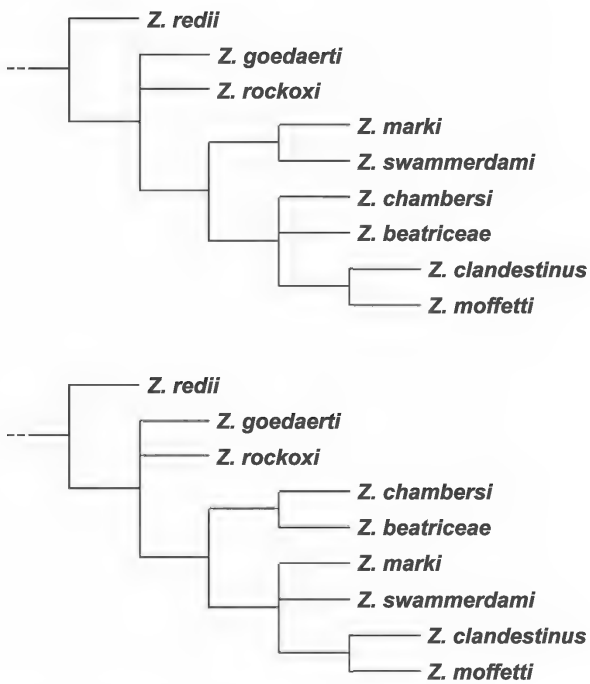


Fig. 99. The two other trees found by implied weighting. Only the *Zyngoonops* clade is shown; the topologies are otherwise identical to that shown in figure 98.

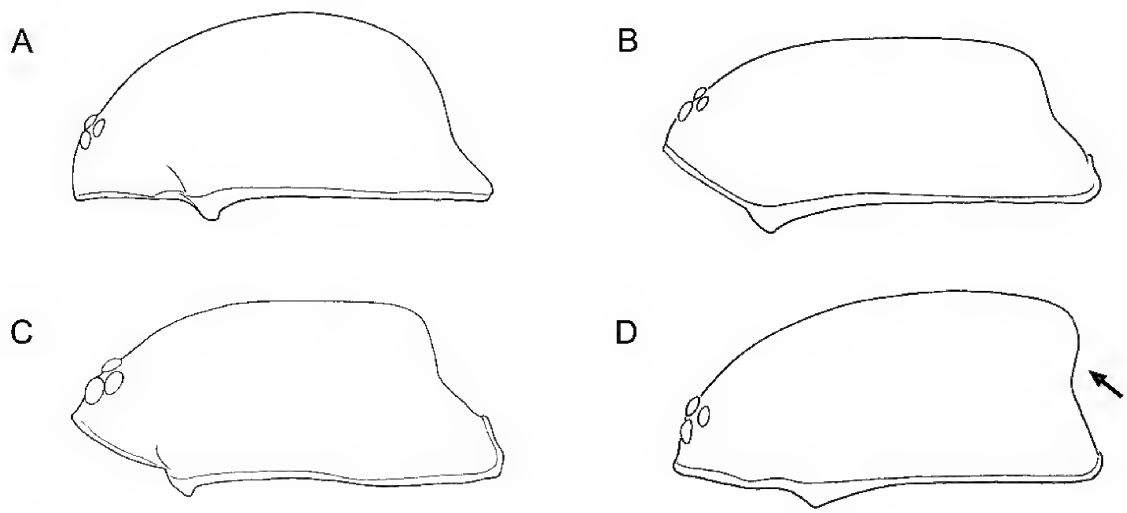


Fig. 100. Character 1, male carapace, posterodorsal part: not reclining (A–C) or reclining (D). **A.** *Antoonops corbulo* Fannes and Jocqué. **B.** *Zyngoonops goedaerti*, new species. **C.** *Zyngoonops swammerdami*, new species. **D.** *Zyngoonops beatriceae*, new species. Arrow: reclining posterodorsal part.

projection of uncertain homology, Px; it, too, is crestlike and situated anterior to the P2 (fig. 33B–D). Given the similarities in shape and position, Pa and Px could be interpreted as P5 homologs. However, there are also conspicuous differences. For example, Pa and Px are relatively small compared to the corresponding P2 (figs. 26A, D, 33B), while the P5 of *Z. chambersi* and *Z. beatriceae* is relatively large compared to the P2 (figs. 39E, F, 47E, 48A, B). *Z. goedaerti* and *Z. rockoxi* have therefore been coded as unknown (?). When they are coded as "absent," there is no difference to the resulting topologies. Coding *Z. goedaerti* and/or *Z. rockoxi* as having a P5 results in longer trees (L = 62).

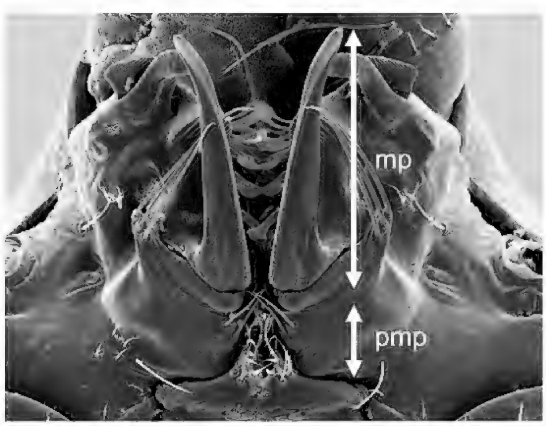


Fig. 101. Character 27, measurements of mp and pmp length.

Male pedipalp

35. Conductor: 0, present; 1, absent. In *O. pulcher*, *M. thevenot*, *Coxapopha,* and *Antoonops*, the embolus is flanked by a conductor (Fannes, 2010b; Fannes and Jocqué, 2008; Ott and Brescovit, 2004; Platnick and Dupérré, 2009). The conductors of *Coxapopha* and *Antoonops* are probably homologous; in both genera, the conductor is an elongated structure situated prolaterally of the embolus (figs. 85, 90E, 93B; Fannes and Jocqué, 2008; Ott and Brescovit, 2004; Platnick, 2000). The conductors of *O. pulcher* and *M. thevenot* are morphologically and topologically considerably different (see Fannes, 2010b; Platnick and Dupérré, 2009), but they are here provisionally considered homologous to those of *Antoonops* and *Coxapopha*. When *O. pulcher* and *M. thevenot* are coded as "absent" (i.e., when their conductors are considered nonhomologous to those of *Antoonops* and *Coxapopha*), the same topologies are recovered. The absence of a conductor is an unambiguous synapomorphy of *Zyngoonops*.

36. Embolus, length: 0, approximately as long as bulb or longer; 1, much shorter than

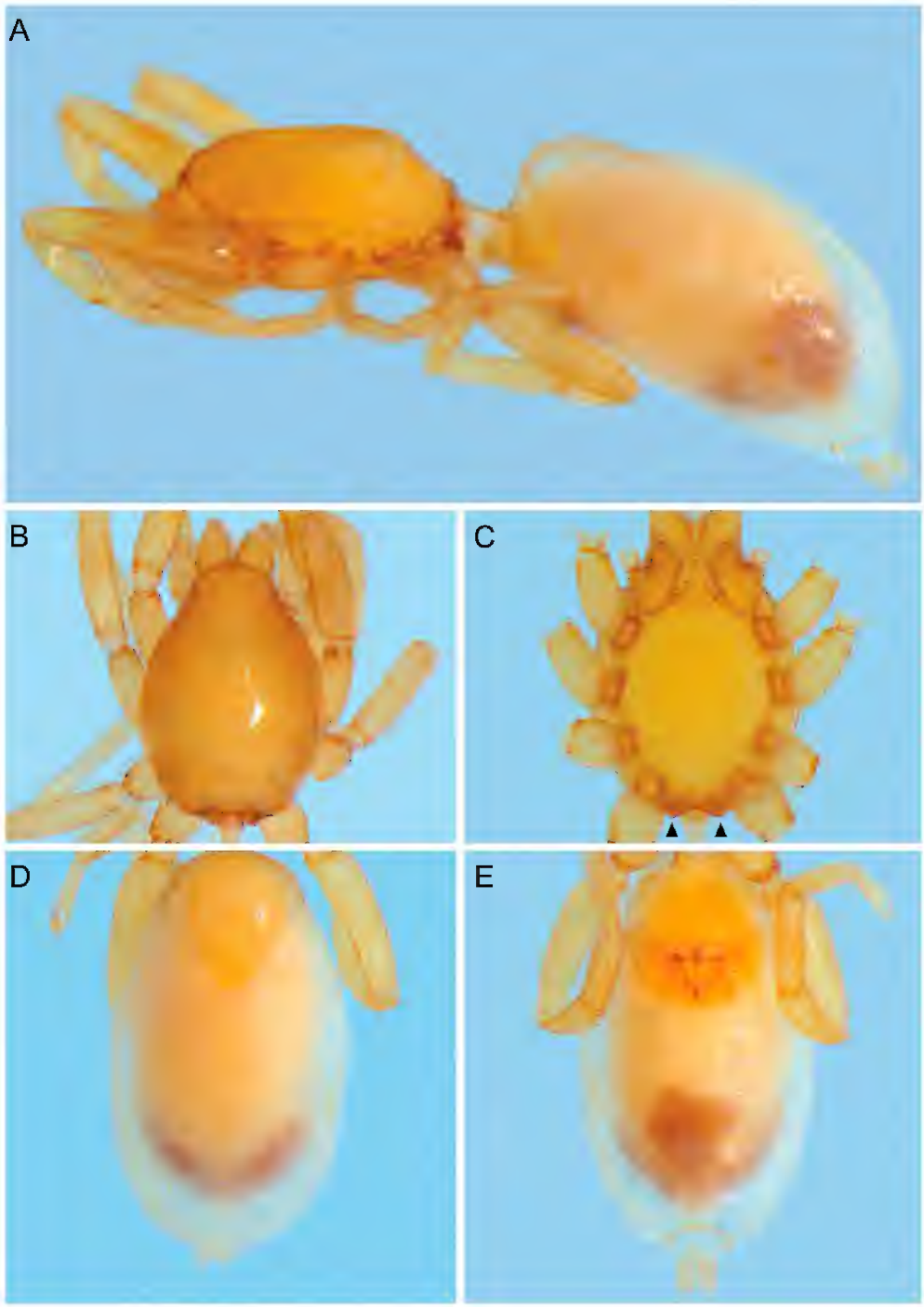


Fig. 102. *Zyngoonops clandestinus* Benoit, female. **A.** Habitus, lateral view. **B.** Carapace, dorsal view. **C.** Same, ventral view. Arrowheads: prongs. **D.** Abdomen, dorsal view. **E.** Same, ventral view.

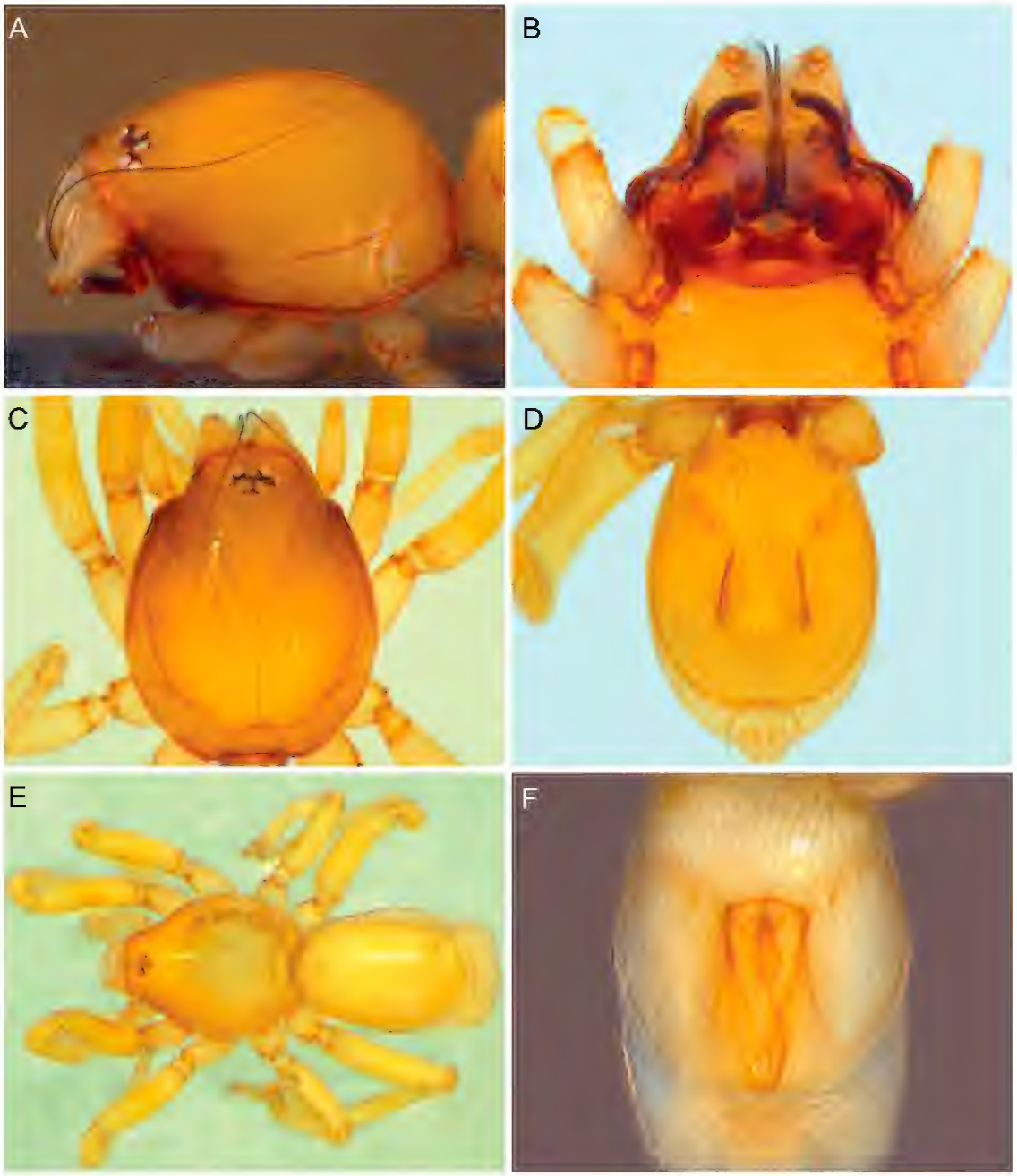


Fig. 103. *Zyngoonops rockoxi*, new species, male (A–D) and female (E, F). **A.** Carapace, dorsolateral view. **B.** Mouthparts, ventral view. **C.** Carapace, dorsal view. **D.** Abdomen, ventral view. **E.** Habitus, dorsal view. **F.** Abdomen, ventral view.

bulb. *M. thevenot* has a complex male palp, and the identity of the embolus remains controversial (fig. 96D; Fannes, 2010b). Here, the "broadened flange" is considered to be the embolus. The ventral surface of this flange shows a fold, which may be the sperm opening (see Fannes, 2010b: 15, figs. 51–54). State 1 is a synapomorphy of the *Zyngoonops*

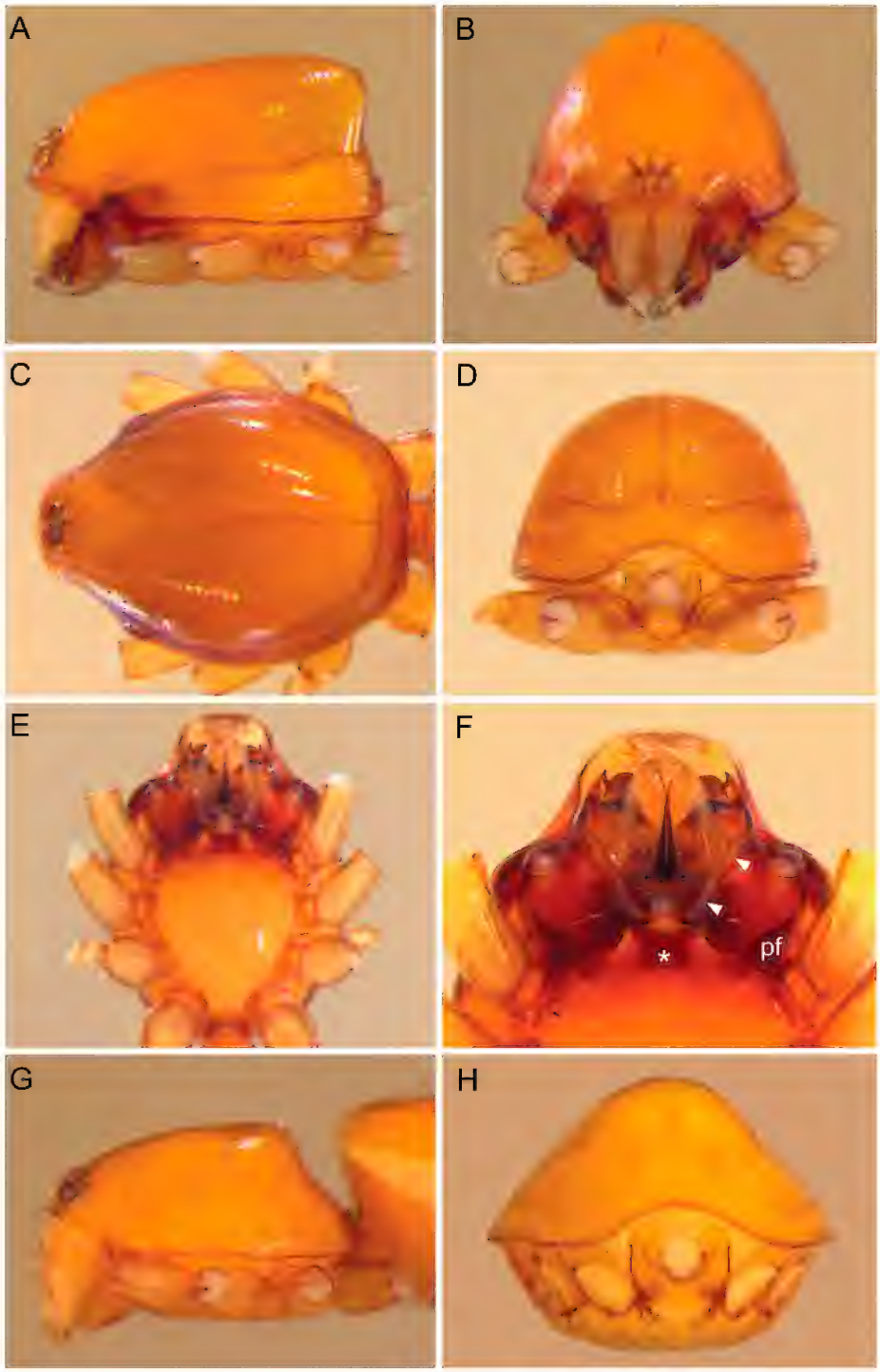


Fig. 104. *Zyngoonops chambersi*, new species, male (A–F) and female (G, H). **A.** Carapace, lateral view. **B.** Same, anterior view. **C.** Same, dorsal view. **D.** Same, posterior view. **E.** Same, ventral view. **F.** Mouthparts, ventral view, showing diagonal band (arrowheads), pleural flap (pf) and structure below the transverse band (asterisk). **G.** Carapace, lateral view. **H.** Same, posterior view.

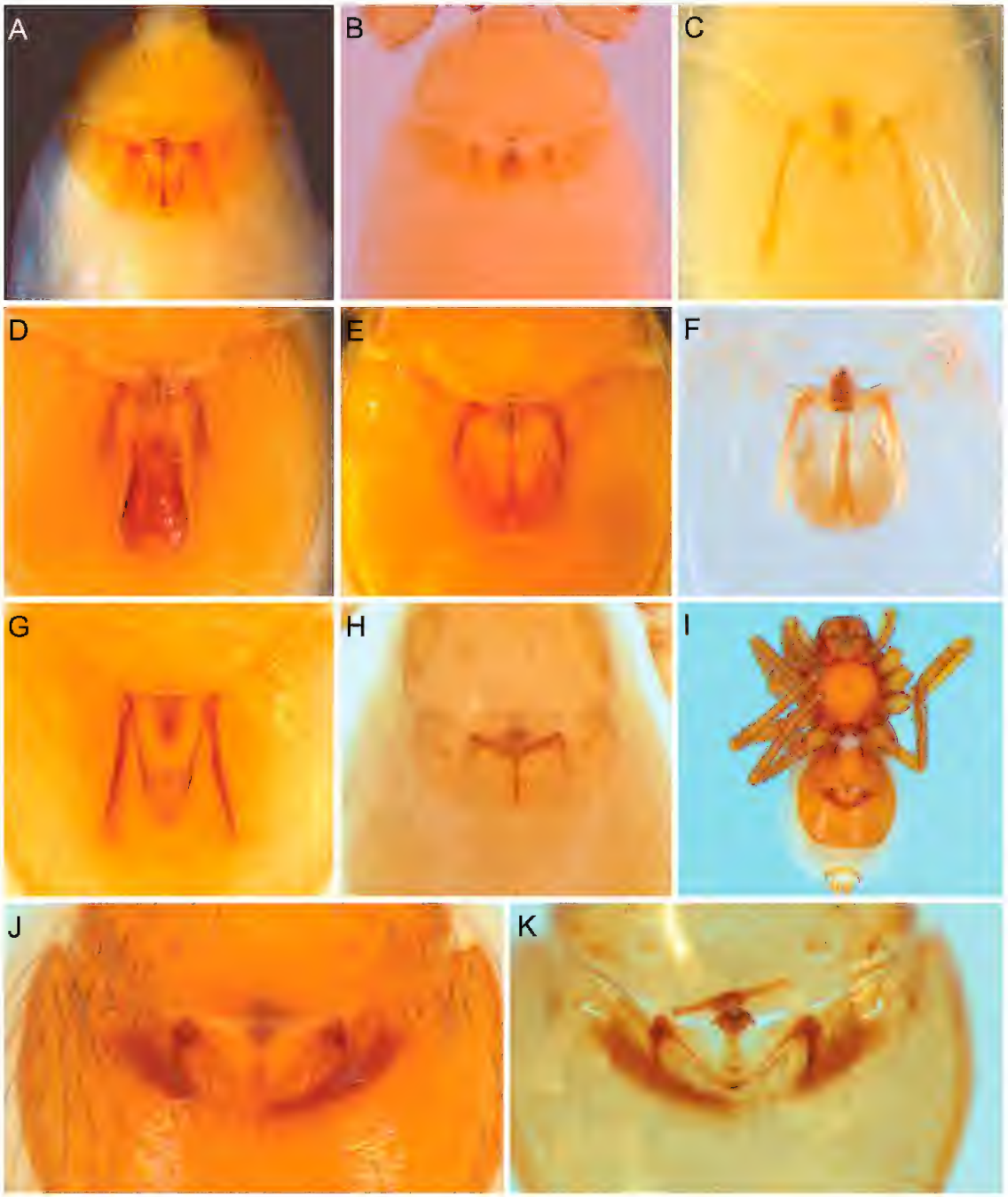


Fig. 105. *Zyngoonops* and *Coxapopha* species, females, genitalia (A–H, J, K) and habitus (I). **A.** *Zyngoonops clandestinus* Benoit, ventral view. **B.** *Zyngoonops moffetti*, new species, ventral view. **C.** *Zyngoonops redii*, new species, ventral view. **D.** *Zyngoonops chambersi*, new species, ventral view. **E.** *Zyngoonops beatriceae*, new species, ventral view. **F.** Same, dorsal view. **G.** *Zyngoonops goedaerti*, new species, ventral view. **H.** *Zyngoonops walcotti*, new species, ventral view. **I.** *Coxapopha* sp., habitus, ventral view. **J.** Same, genitalia, ventral view. **K.** Same, dorsal view.

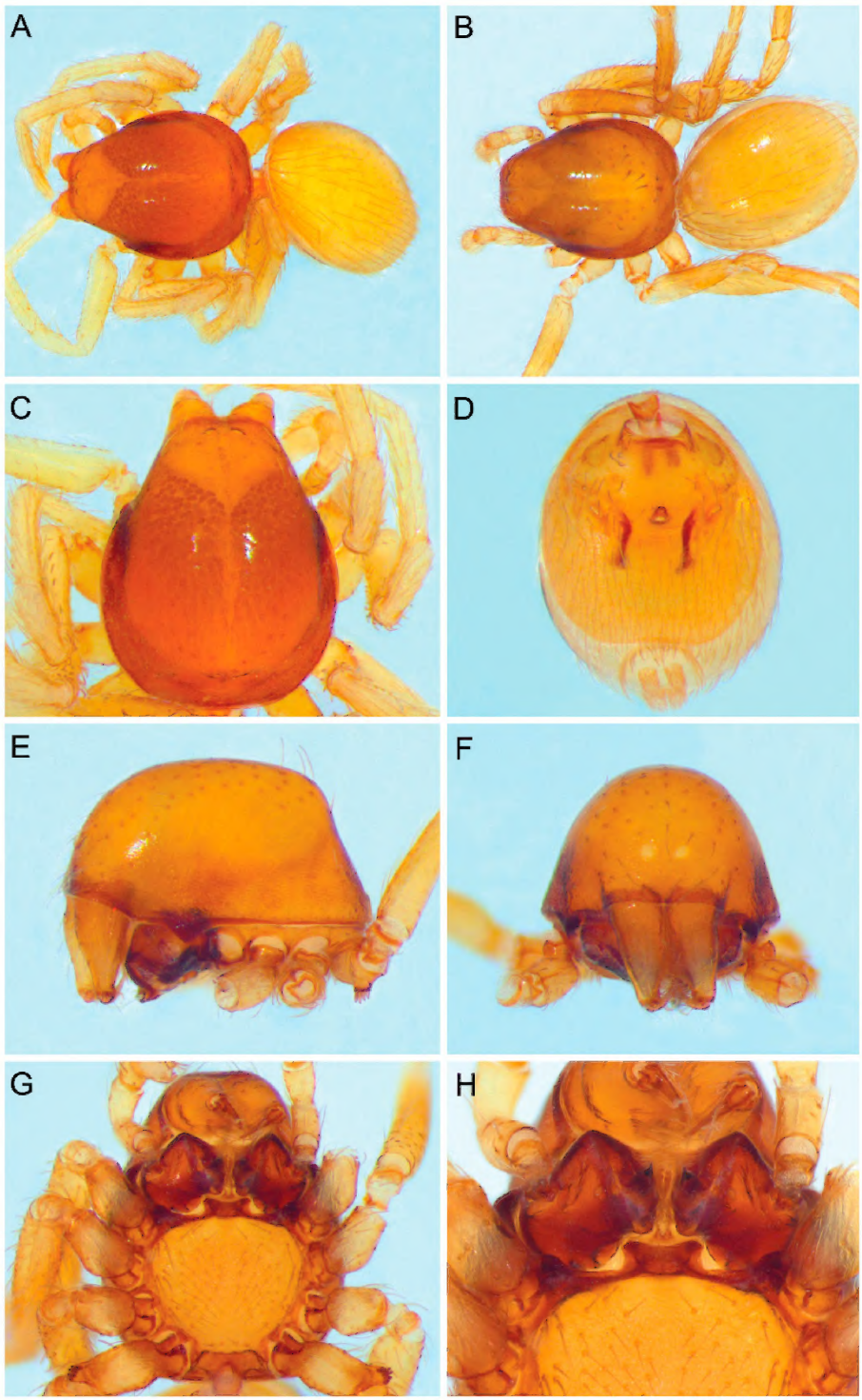


Fig. 106. *Coxapopha diblemma* Platnick, male, holotype (A, C) and specimen PBI_OON 33138 (B, D–H). **A.** Habitus, dorsal view. **B.** Same. **C.** Carapace, dorsal view. **D.** Abdomen, ventral view. **E.** Carapace, lateral view. **F.** Same, anterior view. **G.** Same, ventral view. **H.** Mouthparts, ventral view.

group. Deleting this character does not alter the topology of the MPTs.

37. Embolus, tip: 0, not bent upward; 1, bent upward. In *Antoonops* and *Zyngoonops*, the tip of the embolus is bent upward at an angle of almost 90° (figs. 70F, G, 93B–D). Deleting this character does not alter the topology of the MPTs.

Female genitalia

38. Epigastric scape: 0, absent; 1, present. An epigastric scape is here defined as a well-delineated, relatively large, platelike structure that extends posteriorly from the anterior edge of the PES (see, e.g., figs. 7B, 13B, 52E, 75E, 86D). The scape may or may not be elevated above the PES surface (see fig. 61F for an elevated scape). *Antoonops* lacks an epigastric scape; note, however, that the elevated anterior edge of the PES extends toward the copulatory opening (see fig. 93F and Fannes and Jocqué, 2008: figs. 60–63, 75). In this analysis, the presence of a scape is a synapomorphy of *Zyngoonops*; however, all currently available data indicate that *Coxapopha* females also have a scape (fig. 86D–F; Ott and Brescovit, 2004). It is possible that the scape is synapomorphic for the *Zyngoonops* group, with secondary loss in *Antoonops*.

39. Posterior receptaculum: 0, present; 1, absent. *O. pulcher* has two receptacula, an anterior and a posterior one (see Platnick and Dupérré, 2009: figs. 72–78). *M. thevenot* has only a posterior receptaculum (simply called "receptaculum" in Fannes, 2010b). The absence of a posterior receptaculum is here optimized as a synapomorphy of the *Zyngoonops* group, rather than as a synapomorphy of *Antoonops* + *Zyngoonops*, because *Coxapopha* females lack a receptaculum (fig. 87A–C).

40. Genital pouch: 0, absent; 1, present. Many *Zyngoonops* species have a genital pouch. The pouch is formed by an invagination of the PES and covers the posterior part of the duct (see figs. 55, 56). Species without a long genital duct (*O. pulcher*, *M. thevenot*) are here coded as inapplicable; coding them as absent does not change the topologies. The genital pouch is a synapomorphy of the clade uniting all *Zyngoonops* species except *Z. redii*.

41. Genital duct, distalmost part, shape: 0, not coiled; 1, forming one or two coils; 2, forming more than five coils. Most *Zyngoonops* species have a highly coiled duct (figs. 23E, 43D, E), but *Z. moffetti* has a duct with only one or two coils (fig. 13D–F). The present analysis suggests that the duct of *Z. moffetti* evolved by simplification from a highly coiled duct. An alternative coding scheme would be to split this multistate character into two binary characters, "genital duct: not coiled or coiled" and "number of coils: one or two, or more than five" (the latter being an uninformative character). This scheme results in identical topologies.

Clades

This section summarizes the unambiguous synapomorphies of the most important clades. The listed synapomorphies are common to all three trees. Bremer support values and jackknife percentages (absolute frequencies) are also given.

Zyngoonops group (*Coxapopha* + *Antoonops* + *Zyngoonops*): male carapace with stripes (char. 2); male carapace with extended anterolateral corners (char. 3); paturon posterior surface with five long setae (char. 6); males with pleural flaps (char. 7); groove connecting posterior spiracles absent or indistinct (char. 18); labium of male more than twice as wide as long (char. 25); male endites modified (char. 26); embolus much shorter than bulb (char. 36). Bremer support 6, jackknife 98%.

Antoonops + *Zyngoonops*: male sternum with anterior margin protruding (char. 8); projection P1 present (char. 29); tip of embolus bent upward (char. 37). Bremer support 2, jackknife 66%.

Antoonops: PME clearly separated (char. 5); posteriormost part of sternum demarcated by ridge (char. 12); male abdomen with dorsal constriction (char. 16); sperm pore situated at level of posterior spiracles (char. 17); female ALS with three piriform gland spigots (char. 19); male ALS with three piriform gland spigots (char. 22); median projection projecting posteriorly (char. 28). Bremer support 7, jackknife 99%.

Zyngoonops: paturon posterior surface with three long setae (char. 6); male sternum with anteriorly a transverse band (char. 9); sternum with prongs (char. 11); DS fused to ES in males (char. 15); conductor absent (char. 35); epigastric scape present (char. 38). Bremer support 3, jackknife 87%.

"*Zyngoonops* core clade" (all *Zyngoonops* species except *Z. redii*): projection P2 present (char. 31); genital pouch present (char. 40). Bremer support 0, jackknife <50%.

Z. clandestinus + *Z. moffetti*: posterior eye row lost (char. 4); DS covering about ¼ of abdomen length in females (char. 14). Bremer support 2, jackknife 78%.

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